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The Analysis of the Road Network Assignment Due to Residential

(A Case Study of the Development of Citra Mitra City Residence Banjarbaru)

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***Abstract*—** *By the establishment of Citra Mitra City Residence in Banjarbaru City, it then will cause the attraction and production of the traffic on the roads around the Citra Mitra City Residence, and will also increase the traffic volume. As the research object, that is the Street of Taruna Bhakti. This research used primary and secondary data, with the analysis was carried out by the IHCM 1997, and was assisted by the VISUM Program. The performance of the existing road network of all road sections had the LOS A value with the VC Ratio of 0.01 – 0.19; the performance of the road network while in the development of all road sections still had the LOS A value with the VC Ratio of 0.01 – 0.19; the performance of the road network of the post-development of all road sections had the LOS A value, with the VC Ratio of 0.08 – 0.20; change that occurred was around ±0.17, or 17% were at Street of Citra Mitra City; and the performance of the road network, five years after the development of all road sections, had the LOS A value with the VC Ratio of 0.08 – 0.20. The largest DS decline value was experienced by the road section segment of Citra Mitra City as much as 0.17, and the change of DS value was as musch as 0.01 on the other road sections. Referring to the analysis results, it had been concluded that the development of the DEEPDENE District 4 of Citra Mitra City Residence to the road section in all conditions had not been affected negatively. The next analysis was carried out to obtain the time; a handling needed to be done on the observed road section; after being analysed, it was found a 60-year period after the operational in which the occurred VC ratio value was beyond the limit of ≤ 0.75, that was on section Street of Mistar Cokrokusumo, with the VC Ratio value of 0.85 – 0.88; as for the section Street of Taruna Bhakti was on the VC Ratio value of 0.64*

***Keywords*— level of service, loading, land use.**

I. INTRODUCTION

One of the housing developments in downtown Banjarbaru is the Citra Mitra City Residence Banjarbaru, Sub-district of Cempaka, Municipality of Banjarbaru. By the establishment of such housing, it will then cause the attraction and production of the traffic on the roads around the houding, and will increase the traffic volume. From that condition, it then should be required to carry out analysis about road network Assignment due to the assignment establishment. By creating such analysis, hopefully the traffic disturbances can soon be figured out which later is used as the evaluation material of the road performance, and can give the best solution to overcome the traffic problem in that area.

II. LITERATURE REVIEW

2.1 Definition Traffic Impact Analysis

The analysis of the traffic impact as particular study from the establishment of a building facility and other land uses, to the city transportation system especially the road network around the building location [1]. The analysis of the traffic impact is basically the analysis of the influence of the land use development to the system of the traffic flow trip around it, which is caused by the new traffic production, by the switched traffic, and by the in-and-out vehicles from/to that land [2][3]. The phenomenon of the traffic impact is caused by the establishment and operation of activity center which cause the quite-large traffic production such as office space, shopping center, terminal, residential, and others [4]. The number of trips in the plan year is determined by the characteristic of the land use/land squares (sectors) and also by the socio-economic characteristic of those each sector, which are included in the scope of particular study area such as the town area, regional/province or national [3][5].

2.2 Review of Implementation of Traffic Impact Analysis

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The implementation of the traffic impact analysis in several countries varies based on particular approach/criterion. Nationally, there has been no provision which regulates the implementation of traffic analysis until now. The provisions regarding the recent applied road traffic as in the Minister Regulation No. 96 of 2015 [6], and the Minister Regulation No. 75 of 2015 [7] about the traffic impact analysis and its implementation regulation, do not regulate about the traffic impact.

III. RESEARCH METHODOLOGY

3.1 Activity Flow

The analysis activity in this research can be described into a flow chart as in Figure 1.

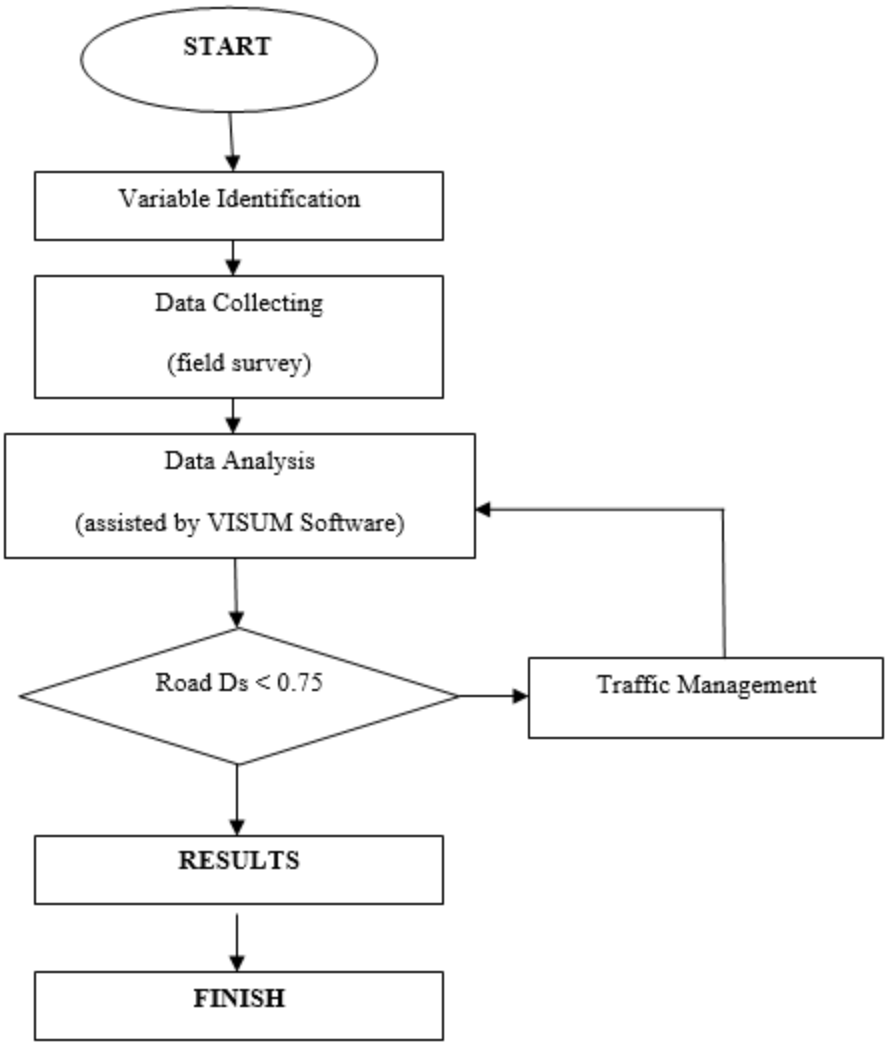

Fig.1: Flow Chart of Analysis

The analysis is to calculate some parameters which influence the section performance such as: degree of saturation, and velocity. The method that is used is the IHCM, 1997 [8], assisted by the VISUM software [9]. The analysis to carry out are:

1. Analysing the condition of the traffic performance around the location before the development.
2. Analysing of how big the attraction and production are, during the housing development.
3. Analysing the condition of the traffic performance after the development.
4. Analysing the impact magnitude caused by the development which influences the traffic performance around, after five years ahead.

The stages in the use of VISUM program which assisted by using the field data in the form of ADT and Destination Origin Matrix , which then inserted in matrix calculation and from some stages of the VISUM program analysis, it can be shown in the form of flow chart as in Figure 2.

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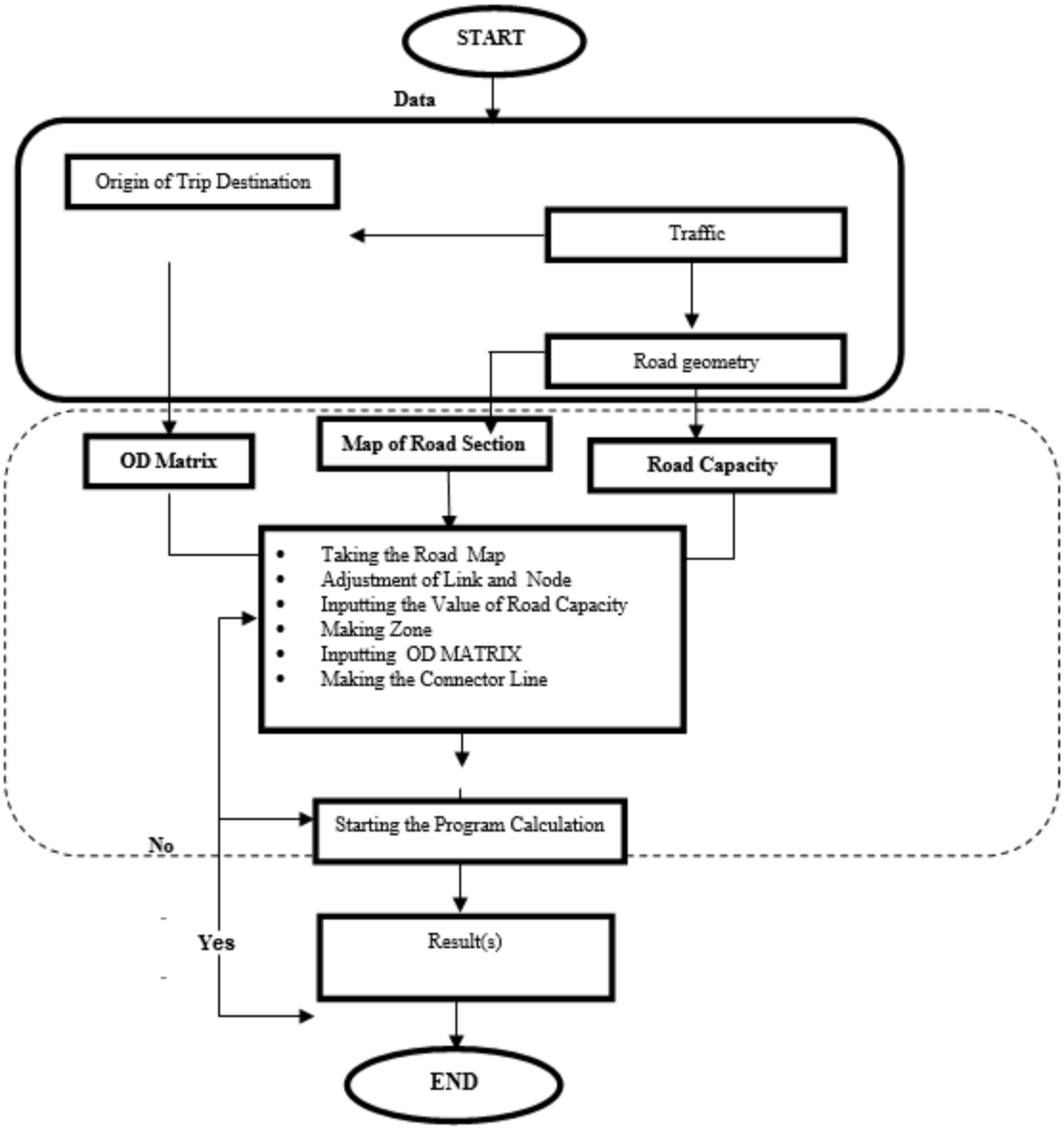

Fig.2: The Flow Chart of VISUM Program Analysis

3.2 Needs of Research Data

This research data includes the primary and secondary data. The secondary data are obtained from the previous research and from the related agencies, including:

1. The data of socio-economic conditions and the General Plan of City Spatial (abbreviated a RUTRK in Indonesian); these data are obtained from the Central Bureau of Statistics and the Regional Development Planning Agency of Banjarbaru city.
2. The data of vehicle ownership and the data of traffic growth rate; these data are obtained from the Department of Transportation of Banjarbaru or the Central Bureau of Statistics of Banjarbaru city.
3. The data of the Citra Mitra City Residence Banjarbaru.

Meanwhile the primary data is obtained by conducting the on-the-field direct survey which includes:

1. The inventory of land use, which is carried out to see the use and potential of the land use around the area of Street of Palam, and the Road influences the production and attraction of the existing trip, and will burden the road.
2. The road network survey, which is carried out by identifying the existing network pattern around Street of Palam and Street of Taruna Bhakti, road section inventory, ADT.

IV. DATA ANALYSIS

4.1 Road Inventory Data

The Geometric conditions of the studied road section, as seen on Table 1.

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Table.1: The Geometric Condition on the Road Section

No.	Road Section Names	Road Type	Width (m)	Road side (m) right	Road side (m) left	Median (yes/no)	Capacity (pcu/hour)
1.	Street of Taruna Bhakti	2/2 UD	6,5	2	2	No	2636
2.	Street of Mistar Cokrokusumo (Cempaka)	2/2 UD	8	2	2,5	No	2916
3.	Street of Mistar Cokrokusumo (Banjarbaru)	2/2 UD	8	2	2	No	2975
4.	Street of Palam	4/2 D	6,5	1,8	1,5	Yes	5080
5.	Street of Merdeka	2/2 UD	4,5	1	1,2	No	1418
6.	Street of Citra Mitra City	4/2 D	13	2	2	Yes	5949
7.	Street of Purnawirawan	2/2 UD	5	1	1	No	1359

4.2 Road Traffic Volume

The results of the traffic volume obtained during conducting the survey can be defined on the graph of the flow fluctuation of each section as shown in Figure 3 until Figure 5.

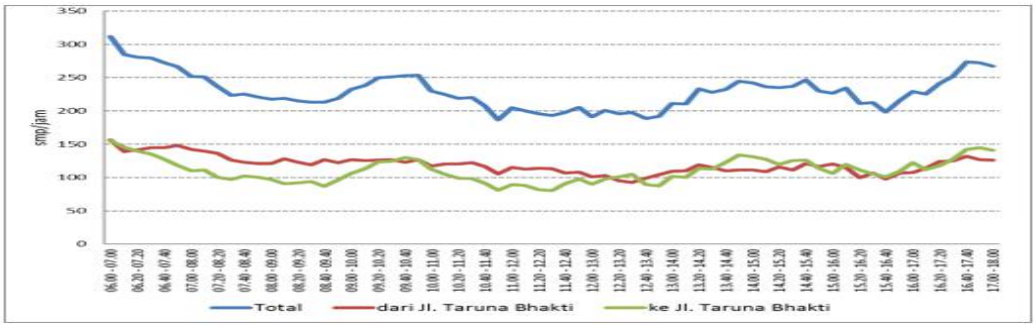

Fig.3: Flow Fluctuation of Street of Taruna Bhakti

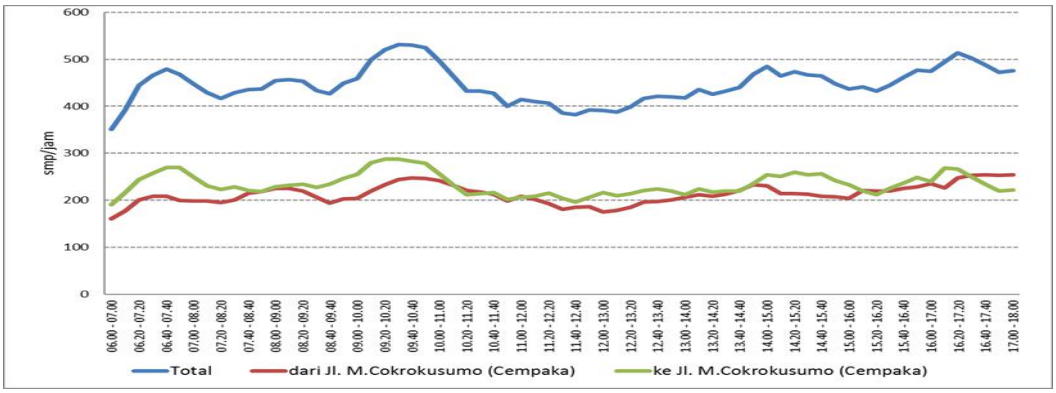

Fig.4: Flow Fluctuation of Street of Mistar Cokrokusumo (Cempaka)

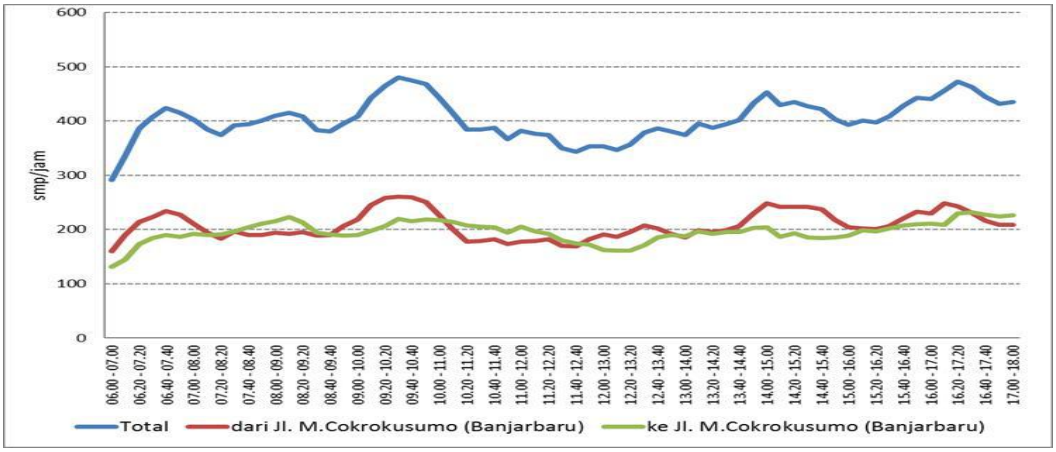

Fig.5: Flow Fluctuation Street of Mistar Cokrokusumo (Banjarbaru)

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The peak volume occurs in the morning period at 9.30 - 10.30 Wita at 480. pcu/hour.

4.3 Trip Demand Data

The trip demand data is used to the traffic model depicting the traffic demand condition, along with the performance of the supplied transportation system service in the study area which is based on the results of the data collecting, both the primary and the secondary. All process of the road network model development is assisted with "*VISUM*," a transportation planning software. According to the characteristic of the road network system in the study area, several road sections are selected to be analyzed and will be used as the road network model of the study area, as in Figure 6.

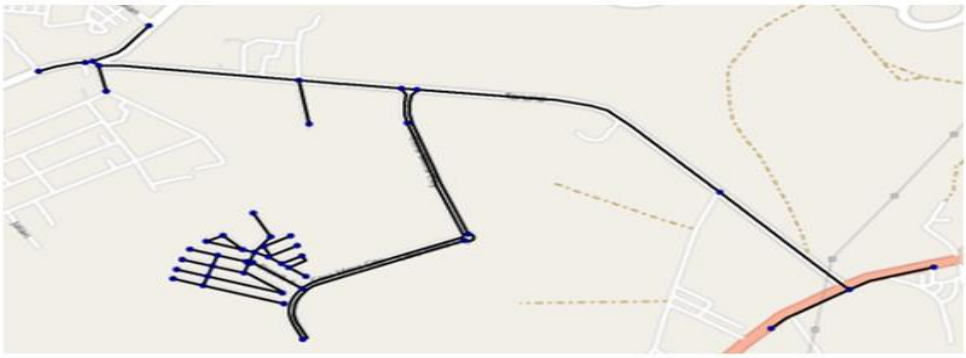

Fig.6: Basic Model of the Selected Road Network of the Study Area

4.3.1. OD Matrix of Basic Year

The estimation of the trip production and distribution in basic year (2018), from every zone in the study area, uses the traffic data approach. In the process, the prior matrix in the pcu/hour unit is charged on the basic year road network model. The form of the road production in the study area in the basic year (2018) is shown in the OD Matrix as on Table 2.

Table.2: The OD Matrix of the Basic Year (2018) in Peak Hour (pcu/hour)

No.	Destination / Origin	1 Banjarbaru	2 Cempaka	3 Taruna Bhakti	4 Merdeka	5 Amanah Park	6 Palam	7 CMC (Distrik 4)	Total
1	**Banjarbaru**	0	173	10	6	2	28	0	219
2	**Cempaka**	149	0	38	10	4	14	0	215
3	**Taruna Bhakti**	12	10	0	32	23	31	0	108
4	**Merdeka**	8	14	21	0	12	70	0	125
5	**Amanah Park**	0	4	7	10	0	36	0	57
6	**Palam**	20	40	36	74	16	0	0	186
7	**CMC (Distrik 4)**	0	0	0	0	0	0	0	0
	Total	189	241	112	132	57	179	0	910

To show the linkage among the zones within the study area, the OD Matrix of basic year (2018) is pictured in the form of desire lines as served in Figure 7.

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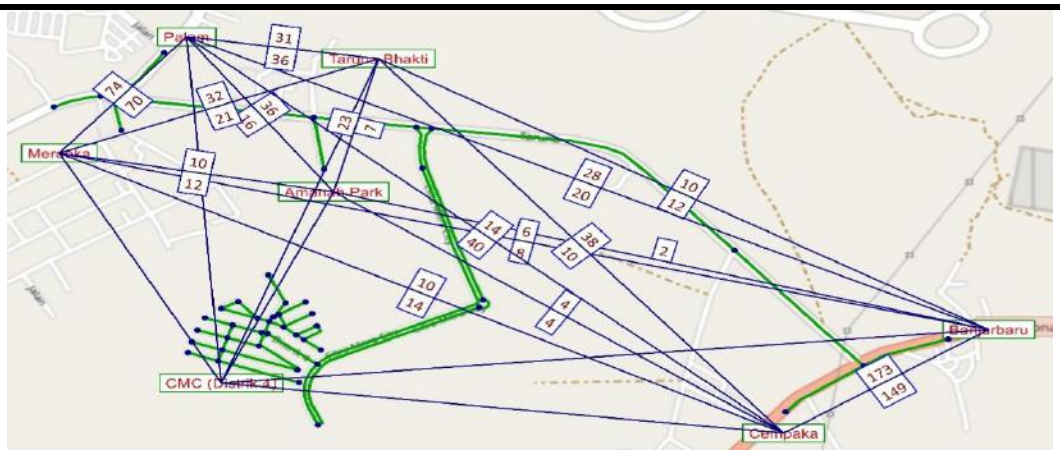

Fig.7: Desire Lines Movement

4.3.2 OD Matrix during Construction

The production and attraction of this goods vehicle are obtained based on the used components namely the number of project workers, and the operational of project vehicle or the project material vehicle, as on Table 3.

Table.3: The Vehicles Used during the Construction

No	Vehicle Type	Amount	pce	Volume (pcu)
1	Motorcycle	40	0,3	12
2	Car	6	1	6
3	Dump Truck	6	1,5	9
	Total			**27**

Below are the distributions of the trip origin/destination during the development as seen on Table 4.

Table.4: The OD Matrix during the Construction in Peak Hour (pcu/hour)

No.	Origin \ Destination	1 Banjarbaru	2 Cempaka	3 Taruna Bhakti	4 Merdeka	5 Amanah Park	6 Palam	7 CMC (Distrik 4)	Total
1	**Banjarbaru**	0	173	10	6	2	24	4	219
2	**Cempaka**	149	0	38	10	4	14	0	215
3	**Taruna Bhakti**	12	10	0	32	23	29	2	108
4	**Merdeka**	8	14	21	0	12	65	0	120
5	**Amanah Park**	0	4	7	10	0	25	5	51
6	**Palam**	20	40	36	74	16	0	16	202
7	**CMC (Distrik 4)**	0	0	0	0	0	5	0	5
	Total	189	241	112	132	57	162	27	920

4.3.3 OD Matrix during Post-Construction

The analysis of the trip production model, which comes from the research object, uses the ITE method with based on the land use type and the activity intensity of a region; the trip production rate is carried out to obtain the value of the trip production level of a region. The procedure used for the analyzing is the ITE (Insitute of Transportation Engineer) method [10], by estimating the land area of a study area in a certain period of time, by not looking too many influenced factors. It is then compared to a variable which becomes the bases (land area, etc.) as on Table 5.

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Table.5: The Attraction and Production of the Comparative Objects [10]

No	Type of Land Use	Morning Peak		Afternoon Peak	
		Enter	Exit	Enter	Exit
1	Office Space (pcu/100m² gross area)	1,17	0,46	0,50	1,19
2	Shopping Center (pcu/100m² gross area)	0,17 (0,25)*	0,08 (0,25)*	0,68 (1,45)*	0,81 (1,68)*
3	Hotel (pcu/room total)	0,32	0,21	0,27	0,27
4	Residential (pcu/unit)	0,06	0,25	0,25	0,12
5	Apartment (pcu/unit)	0,2	0,38	0,29	0,20
6	School (pcu/100m² gross area)	0,16	0,13	0,21	0,17
7	Hospital (pcu/100m² gross area)	0,37	0,26	0,29	0,28
8	Warehousing	0,32	0,38	0,36	0,39

Table.6: The Calculation of the Building Production and Attraction

Land Use	Unit	Info	Vehicle Total (pcu/hour)		Production/Attraction Rate	
			Enter	Exit	Enter	Exit
Citra Mitra City Residence District 4 DEEPDENE	310	Unit	19	78	0.06	0.25

The form of the OD Matrix during the Post-construction is shown on Table 7.

Table.7: The OD Matrix during the Post-construction in Peak Hour (pcu/hour)

No.	Destination / Origin	1 Banjarbaru	2 Cempaka	3 Taruna Bhakti	4 Merdeka	5 Amanah Park	6 Palam	7 CMC (Distrik 4)	Total
1	Banjarbaru	0	183	11	6	2	26	6	234
2	Cempaka	158	0	40	11	4	15	3	231
3	Taruna Bhakti	13	11	0	34	24	31	0	113
4	Merdeka	8	15	22	0	13	69	0	127
5	Amanah Park	0	4	7	8	0	26	0	45
6	Palam	15	38	34	72	17	0	10	186
7	CMC (Distrik 4)	29	10	4	8	0	30	0	81
	Total	223	261	118	139	60	196	19	1016

4.3.4 OD Matrix During 5-year of Post-Construction

The next 5-year of the post-construction production projection (assuming 2-year development) is used the Detroit approach method due to the inhomogeneous of the growth factor of all zones. Such form of the OD Matrix 5 years later is shown on Table 8.

Table.8: The OD Matrix of the 5-year post-construction in the Peak Hour (pcu/hour)

No.	Destination / Origin	1 Banjarbaru	2 Cempaka	3 Taruna Bhakti	4 Merdeka	5 Amanah Park	6 Palam	7 CMC (Distrik 4)	Total
1	Banjarbaru	0	211	12	7	2	30	7	269
2	Cempaka	182	0	45	12	5	17	4	265
3	Taruna Bhakti	15	12	0	39	28	35	0	129
4	Merdeka	10	17	25	0	14	79	0	145
5	Amanah Park	0	5	8	10	0	30	0	53
6	Palam	17	43	39	83	19	0	11	212

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7	**CMC (Distrik 4)**	33	12	5	10	0	34	0	94
	Total	257	300	134	161	69	225	22	1168

4.4 Road Network Performance Simulation

By considering the valid network system to every road section, the traffic tripin the form of OD Matrix, and the road capacity of each observed road section, then by using the VISUM Software, the performance value and the traffic flow tripcan be obtained, as shown in Figure 8 until Figure 11. Further, the LOS value of every section is recapitulated as described on Table 9.

4.5 Results Discussion

4.5.1 Impact Forecast

The evaluation of the impact on the road section can use the indicator of the occurred Degree of Saturation (DS). From the results of the analysis of road network for those four conditions, the changes of the DS for each condition can be seen as on Table 9.

Fig.8: LOS and the Amount of the Traffic Flow of the Road Section at Existing Condition at Peak Hour

Fig.9: The LOS Simulation and the Amount of the Traffic Flow of the Road Section during the Development at Peak Hour

Fig.10: The LOS Simulation and the Amount of the Traffic Flow of the Road Section of Post-development at Peak Hour

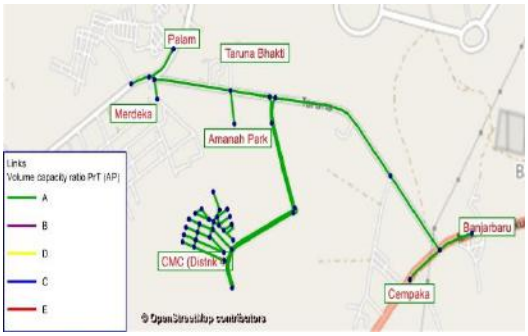

Fig.11: The LOS Simulation and the Amount of the Traffic Flow of the Road Section of the 5-year Post-development at Peak Hour

Table.9: Changes of the DS Value

No.	Road Section Name	Degree of Saturation (DS)				LOS
		Existing Condition	Development Condition	Post-development Condition	Condition after 5 Years of Post-development	
1	Street of Mistar Cokrokusumo (Banjarbaru)	0,15	0,15	0,16	0,16	A
2	Street of Mistar Cokrokusumo (Cempaka)	0,17	0,17	0,18	0,18	A
3	Street of Taruna Bhakti	0,14	0,14	0,15	0,15	A
4	Street of Merdeka	0,19	0,19	0,2	0,2	A
5	Street of Purnawirawan	0,14	0,14	0,15	0,15	A
6	Street of Palam	0,06	0,06	0,08	0,08	A
7	Street of Citra Mitra City	0,01	0,01	0,18	0,18	A

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Almost all observed road sections experience DS value reduction as the impact of the development and the growth of the existing traffic flow. The largest DS value reduction is experienced by the segment of the street section of Citra Mitra City as much as 0.17; and in other road sections, the DS value reduction is as much as 0.01; the LOS value does not experience any change, and remains having the LOS A.

4.5.2 Handling Implementation

From the DS value of every condition, and concerning the criterion limit of the allowed DS value, then generally the road sections in the observed area are still below the required limit value for the handling (> 0.75). Furthermore, the correlation of the DS value for those four conditions, towards the required limit value, is illustrated as in Figure 12.

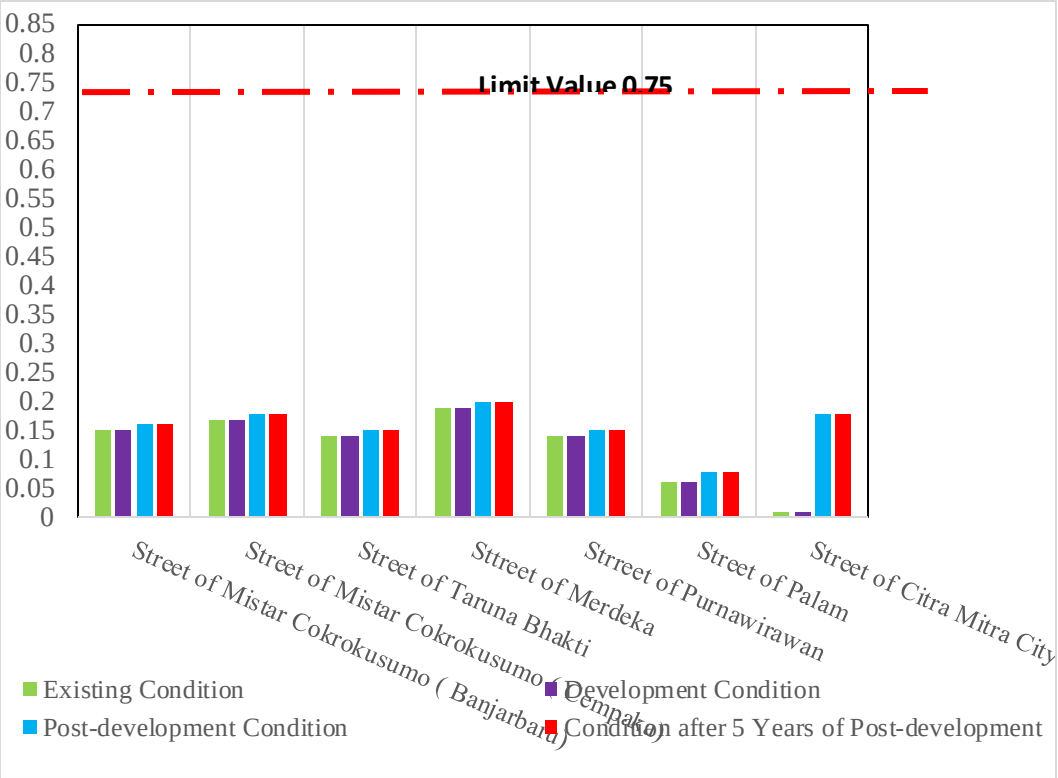

Fig.12: The DS Values of Each Condition towards the Limit Value of Handling

All the DS values of the observed road section are below the limit value (< 0.75), and this hints that no handling is needed in those road section.

4.5.3 Traffic Impact Prediction

From the results of the traffic impact analysis, along with the development of the Citra Mitra City Residence Distric 4 DEEPDENE, it can be obtained up to 5 years of post-construction. With the largest DS value of 0.20, a sequel analysis needs to be carried out to obtain the time where the observed road sections need the handling. In this analysis, assuming there is no additional number of housing, and the surrounding condition is normal/existing, the traffic condition is normal, and the traffic growth rate uses the growth rate as on Table 10.

Table.10: Growth Rate

	Zone	Growth	
		i	60
1	Banjarbaru	2.95	5.72244
2	Cempaka	2.77	5.15207
3	Taruna Bhakti	2.77	5.15207
4	Merdeka	2.77	5.15207
5	Amanah Park	2.77	5.15207
6	Palam	2.83	5.33568
7	CMC (District 4)	2.77	5.15207

Based on the analysis results, it can be obtained that the traffic impact of that development occurs in 60 years from the post-construction. The production projection in the next 60 years uses the approaching method of Detroit since the growth factors of all zones are non-homogeneous. The form of the OD Matrix in the next 60 years is shown on Table 11.

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Table.11: The OD Matrix, 60 years of the post-construction at Peak Hour (pcu/hour)

No.	Origin \ Destination	1 Banjarbaru	2 Cempaka	3 Taruna Bhakti	4 Merdeka	5 Amanah Park	6 Palam	7 CMC (Distrik 4)	Total
1	Banjarbaru	0	948	66	38	13	160	36	1260
2	Cempaka	819	0	171	43	18	64	12	1127
3	Taruna Bhakti	76	43	0	159	116	152	0	546
4	Merdeka	50	60	108	0	60	340	0	618
5	Amanah Park	0	17	36	40	0	133	0	227
6	Palam	95	167	177	363	87	0	45	933
7	CMC (Distrik 4)	161	41	19	37	0	139	0	397
	Total	1200	1275	577	680	294	987	93	5107

At the same time, with the similar way, the value of the road network performance in the 60 years of post-development can be simulated as shown in Figure 13.

Fig.13: The LOS Simulation and the Amount of the Traffic Flow of Road Section, 60 Years of Post-development at Peak Hour

The LOS value for every observed section in that area in the projection year (after 60 years) due to the traffic flow growth, and the operated housing are recapitulated as described on Table 12.

Table.12: The LOS of the Observed Sections at Peak Hour, 60-year Condition of Post-Development

Section	DS	LOS
Banjarbaru	0.85	D
Cempaka	0.88	D
Taruna Bhakti	0.64	C
Merdeka	0.66	C
Purnawirawan	0.32	B
Palam	0.39	B
Citra Mitra City	0.18	A

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In terms of the occurred VC ratio value in the road sections of the 60-year post-development, the VC ratio which exceeds the limit of ≤ 0.75 is in the section of Street of Mistar Cokrokusumo, with the value of VC Ratio of 0.85 – 0.88; the section of Street of Taruna Bhakti is in the value of VC ratio of 0.64; thus, there needs handling in the sections of Street of Mistar Cokrokusumo and Street of Taruna Bhakti.

The analysis results per 5 years can be seen in Figure 14.

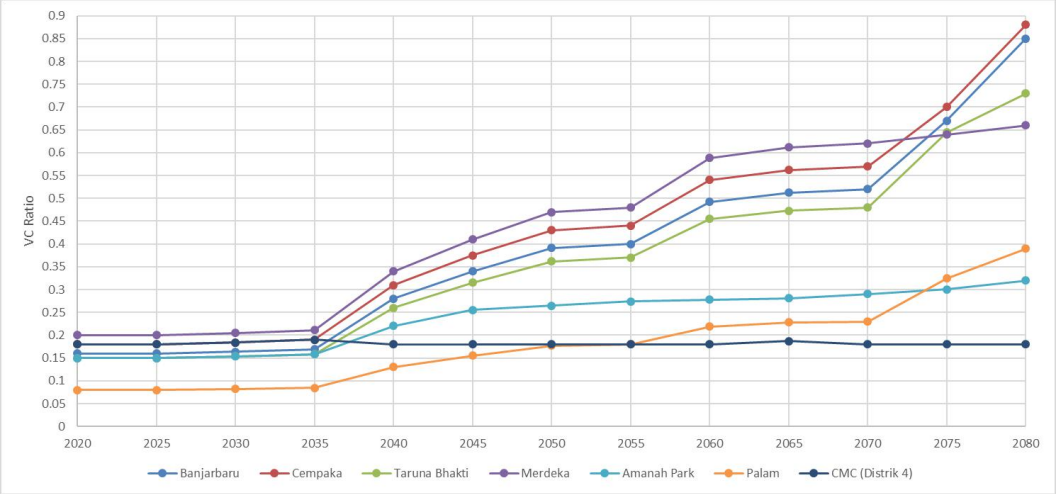

Fig.14: The Increment of VC Ratio per 5 years

V. CONCLUSION

The performance of the existing traffic in all observed road sections was still in the good category, which was reviewed from the value of VC Ratio ranged between 0.01 – 0.19, or in other words, the LOS showed the A value. The identification of the traffic impact, from the housing development to the traffic Assignmentin the road sections around the housing location, was carried out in three conditions namely in a condition during the development, in a condition after the development, and in a condition after 5 years of the development. From the analysis results, that in the condition during the development, the performance in terms of the LOS value in all road sections had a value of A, along with the VC Ratio which experienced changes ranged around 0.01 – 0.02 from the existing condition. In the condition of post-development and 5 years of post-development, the performance in terms of the LOS value in road section had a value of A, along with the VC Ratio which experienced changes of 0.01 – 0.17 from existing condition. It can be concluded based on the analysis results that the road sections around the housing development did not experience the traffic Assignmentimpact which led to the degradation of the road section performance. The traffic impact in the observed Road sections existed in the 60 years of post-development, for the VC ratio was on the value of 0.99, and the LOS was D.

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