International Journal of GEOMATE, July, 2020, Vol.19, Issue 71, pp. 115 - 122
ISSN: 2186-2982 (P), 2186-2990 (O), Japan, DOI: https://doi.org/10.21660/2020.71.08550
Geotechnique, Construction Materials and Environment

THE EFFECT OF THE DEVELOPMENT OF INDUSTRIAL AND COMMERCIAL AREA ON ROAD NETWORK PERFORMANCE (WARU SURABAYA – MOJOKERTO STREET)

*Budi Sugiarto Waloejo[1], Gunawan Prayitno[1]

[1]Urban and Regional Planning, Brawijaya University, Indonesia

*Corresponding Author, Received: 30 Aug. 2019, Revised: 02 Jan. 2020, Accepted: 28 Feb. 2020

ABSTRACT: The development of the industrial zone outside the area of the city of Surabaya increased rapidly. A problem arises when most industrial zones clutter the streets from the main collector between cities (Surabaya-Mojokerto street, Waru Surabaya-Sidoarjo street and Surabaya-Gresik street). The purpose of this study are; (1) find out the characteristics of land use, (2) obtain a network model of interaction with land use and measure the level of service of the corridor, (3) discover the effect of the contribution of current flows from industrial zones to level road services in the corridor. Descriptive method with qualitative analysis, correlational method and quantitative analysis which includes: a stepwise regression analysis, an ANOVA analysis for land use / attraction and Indonesia Road Capacity Manual (IRCM) to calculate the level of service of the road. The results showed that V_total = 21,275 pcu / day (internal) + 55,426 pcu / day (external) = 76,701 pcu / day. The trip is higher than the road's capacity which reaches 5,810 pcu / hour. The road service level is poor at certain times; noon and afternoon. The influence of the traction volume drawn from the industrial zone outside the industrial zone is 8.882 pcu / day or 41.75% of total land use and advertisements are 4.053 pcu / day or 19.05% of total land use. While the flow of local movements from land use planning contributed 21,275 pcu / day or 28% of the total volume of traffic movement on the main road section.

Keywords: Industrial zone, Land use, Network model, Traffic movement.

1. INTRODUCTION

Urban development in the past two decades is promoting the development of mixed land use to become a compact city, that will reduce the generation or attraction the traffic movements [1, 2]. The negative impact of movement in urban areas, related to transportation, which would likely reduce the level of pedestrians and bicycles and increase the use of private vehicles, so that it could cause congestion on these roads [3]. The idea, base Corvero idea [1, 2] which is states that mixed land use contributes to reducing travel volume, will not apply to the study area. There is a need for transportation models to measure the level of mixed land use. The integrated movements generate by the use of mixed land with road network systems. The typology of Asian cities is different from American or European cities [4]. Mixed land use linear along the main roads of the city are common characteristics of urban development in Indonesia. In most cases, mixed land use develops in the main roads of the cities tend to turn housing into commercial and industrial use. This will cause congestion on the road, from the accumulation of internal movement between cities [5].

The Surabaya City Government policy in the era of the 1990s encouraged the development of industrial area to get out of the urban areas of Surabaya because the density was already very high in urban areas. This policy has an impact on the emergence of Industrial Area outside of Industrial Estates which are scattered in the Gerbangkertosusila area [6]. The Waru Surabaya-Mojokerto street section is one of the primary collector roads which is mixes landuses development. This is starting from: housing, education, offices, health, trade & services, and industry. Land use which dominates mainly is industrial zones (73 industrial zones) and 84 commercials areas (trades & services). This is one of the reasons for choosing a central industrial location, commercials, and other activities related to accessibility. Industrial estates have caused several impacts related to transportation. One of the impacts is the loading and unloading of goods or raw materials that occur can cause congestion delays [7]. The level of road services has a significant effect on the development of changes in land use or growth in land use on certain roads [8]. Their study combine land use models with transportation models to display the interaction of land use systems and urban road network systems over time in a combination of combined interaction models. The advantage of this approach is that exogenous data input is needed eg the land use model can be calculated directly on the local

land use (internal volume) added by continuous current flow (external volume) and vice versa [9].

Congestion is a big problem in the cities in Indonesia. One of the causes of congestion is the large number of traffic movements has exceeded road capacity. Reduced effective road space can reduced road capacity. Reduced effective road space can be caused by vehicles parked on the road or other activities such as street vendors, etc [12]. Congestion is also influenced by urban land use, that the land use function can form a resurrection zone pattern, a zone of pull movement or the volume of internal movement flows on the road segment [4].

This study aims to determine the characteristics of the development of land use along Waru Surabaya and Mojokerto road segment. The calculation of land use interaction model, road network system, measure the service level of the corridor and find out the effect of the contribution of the current flow of industrial zones to the level road services in the corridor.

Integration of land use and transport planning is known as an important component of creating sustainable cities [10]. Land use development planning, infrastructure investment, and regulation in transportation planning need to accommodate the changes in land use behavior and traveling behavior from land use activities [11]. The linkage between land use and transportation is in the trip generation and attraction factor. Increasing the trip generation and attraction is proportional to the increasing load of the existing road around the land [6].

2. RESEARCH METHOD

The type of research used is descriptive research. Descriptive research is research that is used to make a study of the situations or events in a research location systematically, factually, and accurately regarding the facts and characteristics of the population at the location of the study. The descriptive approach taken to produce output is related to the general description of traffic conditions, land use, characteristics of road network, and land use growth in the corridor of Surabaya-Mojokerto Road.

In addition, this research can be categorized as correlational research because this research detects the extent to which independent variables influence a fixed variable by forming multiple regression models based on the correlation coefficient.

Some quantitative methods used include analysis of road loading characteristics (analysis of degree of saturation), analysis of generation and trip pull (multiple linear regression analysis), and modeling of land use interactions. From the interaction of the model it can be seen the level of road service that occurs [13].

Data collection methods used: primary survey consists of: field observations, interviews/ questionnaires, traffic counting, recording vehicle license platesand and cross-sectional measure-ments of the road. Secondary surveys consist of: literature surveys, agency surveys and similar research studies.

Partial correlation in the study is use to measure the correlation between the independent variable and the dependent variable by controlling one of the independent variables to see the natural correlation between uncontrolled variables. Partial correlation analysis involves two variables. One variable that is considered influential will be controlled or made fixed as a control variable [4].

$$r = \frac{n\sum_{i=1}^{n} XiYi - \sum_{i=1}^{n} Xi.\sum_{i=1}^{n} Yi}{\sqrt{n\sum_{i=1}^{n} Xi^2 - \left(\sum_{i=1}^{n} Xi\right)^2}.\sqrt{n\sum_{i=1}^{n} Xi^2 - \left(\sum_{i=1}^{n} Xi\right)^2}}$$

Notes:
r = Correlation coefficient
n = Respondent
X= Varible X_{Score}
Y= Variable Y_{Score}

If the value of Y tends to increase with the followed X value is also increased, then the correlation is called the direct correlation. Conversely, if Y tends to decrease, while the value of X increases, then the correlation is called negative correlation or inverse correlation. The correlation between these variables can be expressed by a correlation coefficient (r). The r value has a range between -1 to +1. The value is a perfect value, while the value 0 is the smallest value.

Multiple linear regression analysis conducted to determine land-use interaction model with the road network, so it can be known how much internal volume derived from land use activities. The method used in this case is the stepwise method. The stepwise method is a method that selects explanatory variables (independent variables) based on the largest partial correlation with the variables already included in the model. The variables that have been included in the model can be removed again, so that the necessary steps become more [12].

$Y = a + b_1X_1 + b_2X_2 + ... + b_nX_n$

Notes:
Y = Dependent Variable
$X_1 \ldots X_n$ = Independent variable
a = Contanta

$b_1 \ldots b_n$ = Regression coefficient

Capacity on Road (Equation 1):

$$C = C_O \times FC_W \times FC_{SP} \times FC_{SF} \times FC_C \quad (1)$$

Notes:

C = Capacity (pcu/hour)
C_O = Basic Capacity (pcu/hour)
FC_W = Traffic Length adjustment factor
FC_{SP} = Median Adjustment Factor or Direction Separator
FC_{SF} = Side Constraint Adjustment Factor
FC_{CS} = City Size Adjustment Factor

Road network performance or service level using the following calculation (Equation 2):

$$\boldsymbol{VCR = \frac{V}{C}} \quad (2)$$

Road Network – Land Use Interaction Model [14]:

$$VCR = \frac{\sum \boldsymbol{Vinternal} + \sum \boldsymbol{V_{Ekternal}}}{\boldsymbol{C}} \quad (3) \quad (3)$$

Notes:
VCR = Ratio Volume Capacity (level of servive)
V = Traffic Volume (pcu/hour)
$V_{internal}$ = Amount of Vehicle Volume from Generation/Attraction of Land Use
$V_{external}$ = Amount of on-going Vehicle Volume on the Main Street
C = Road Capacity (pcu/hour)

The analysis used to find out how the relationship between land use and road network using the following equation (equation 4):

$$\boldsymbol{V_{total} = V_{Internal} + V_{External}} \quad (4)$$

Notes:
V_{Total} =Total volume of vehicle movement per hour in the corridor on the main road.

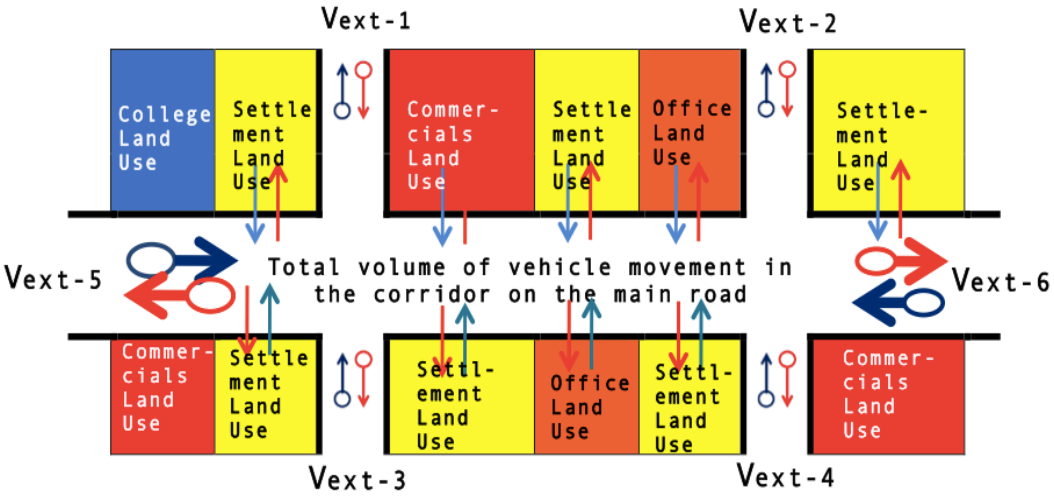

Fig. 1. Land Use and Road Network Model [14]

V_{Total} =Total volume of vehicle movement per hour in the corridor on the main road.
$V_{Internal}$ =Total volume of vehicle movement/hour from generation or attraction of land use.
$V_{External}$ =Total volume of external vehicle movement per hour in the main road corridor of vehicle movement volume per hour from neighborhood roads or alleys plus continuous volume of vehicle movement per hour on the main road.

$$\boldsymbol{V_{internal} = e_1 Y_1 + e_2 Y_2 + e_3 Y_3 + \cdots e_n Y_n} \quad (5)$$

Total volume of movement of vehicle / hour from land use in the corridor of the main road.
Notes:
$e_1 = V_1/Y_1$ = Volume ratio of vehicle movement out or incoming from the land use at certain hours compared to the total volume of vehicle movement per day.
Y_1 = Volume of vehicle movement per day of influence of the trip generation/ attraction of land use for housing
Y_2 = Volume of vehicle movement per day of influence of the trip generation or attraction for education
Y_3 = Volume of vehicle movement per day of influence of the trip generation or attraction for healthy
Y_4 = Volume of vehicle movement per day of influence of the trip generation or attraction for Offices
Yn = Volume of vehicle movement per day of influence of the trip generation or attraction for Land use

while:
$V_{External}$ = Total volume of vehicle movement

external per hour present in the corridor of the main road

$$\boldsymbol{V_{External} = V_{Eks-1} + V_{Eks-2} + \cdots + V_n \ldots + V_{Eks-5} + V_{Eks-6}} \quad (6)$$

V_{Eks-1} = Volume of vehicle movement per hour from neighborhood streets / alleys - 1

V_{Eks-2} = Volume of vehicle movement per hour from neighborhood streets / alleys – 1

V_{Eks-5} = The continuous volume of vehicle movement per hour on the main road

V_{Eks-6} = The continuous volume of vehicle movement per hour on the main road

Based on trip attraction and generation, we proposed a mathematical model using correlation between response variable (the sum of trip generation/attraction) and independent variables. We proposed 9 (nine) independent variables as follows:

1. Residentials; X_1= building area, X_2= number of bedrooms, X_3= number of household's members, X_4= number of motorized vehicles possessed by the family, X_5 = family income.
2. Schools (kindergarten to high school); X_6= number of students, X_7= number of teachers/employees, X_8= number of classrooms, X_9= land area, X_{10}= building area.
3. Universities; X_{11}= building area, X_{12}= number of students, X_{13}= number of lecturers/employee, X_{14}= number of courses.
4. Offices; X_{15}= number of employees, X_{16}= number of visitors/guests, X_{17}= land area, X_{18}= building area.
5. Hospital; X_{19}= number of doctors, X_{20}= number of daily patients, X_{21}= spacious inpatient room, X_{22}= parking area, X_{23}= building area.
6. Chemists; X_{24}= number of employees, X_{25}= number of customers, X_{26}= building area, X_{27}= parking area.
7. Commercials; X_{28}= parking area, X_{29}= building area, X_{30}= number of employee, X_{31}= number of visitors.
8. Fuel station; X_{32}= number of employees, X_{33}= built up area.
9. Industries; X_{34}= number of employees, X_{35}= Frequency of delivery of goods, X_{36}= parking area

3. RESULT AND DISCUSSION

3.1 Corridor Characteristic of Waru Surabaya-Mojokerto

Characteristics on roads Waru Surabaya-Sidoarjo Corridor road is a 4/2 D, with hotmix asphalt pavement. The Waru Surabaya-Mojokerto road corridor has a road median with a width of 2.5 meters along the road. Related to the width of road (Space Benefit Road) which is equal to 10 meters with the division of each lane is 5 meters. Effective road shoulder width for Waru Surabaya - Mojokerto road segment is < 0.5 meter (Figure 2).

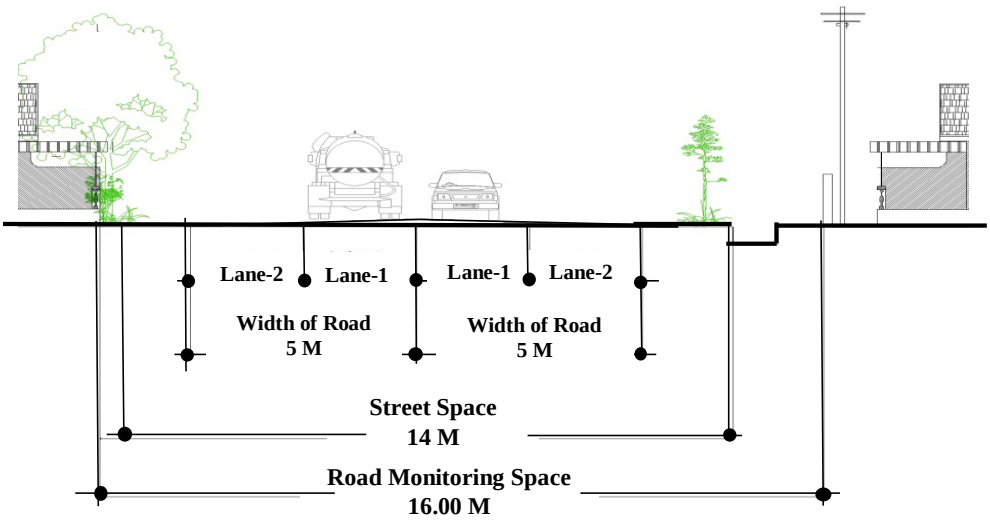

Fig. 2 Cross Section of Waru Surabaya-Mojokerto Road

There are some side activities of the road (side barriers) such as on street parking activities ranging from two-wheeled vehicles, four wheels to heavy vehicles. Besides other side barriers that is the activity of the entry of the vehicle from the surrounding land. Associated with the calculation approach of road capacity coefficient has value C_O 6.600, FC_W 0,92, FC_{SP} 1, FC_{SF} 0,92, FC_{CS} 1,04, and has a capacity value of roads of 5.810 (pcu/hour).

Table 1 Road network characteristic of Waru Surabaya-Mojokerto Roads

Road Characteristic	Waru Surabaya-Mojokerto Road
Type	4/2 D
Direction Flow	West-East and East-West
Lane	4
Flow System	2 Ways
Width of Road (m)	10
Material	Asphalt Hotmix
Width of Road (m)	5
Sidewalk (m)	-
Road Side	0,5 m and 0,50 m
Median (m)	1.5
Parking	On Street And Off Street
Type of Land Use	Commercials, Office, Industry, etc.

3.2 Land Use Characteristic

Land use in the road corridor from Waru Surabaya-Mojokerto with total land use area of 7.531.505 m^2 dominated by Industrial land use with an area of 6.494.743 m^2 or 86.2 per cent of the total area while the smallest land use area is a Chemists with an area of 2.692 m^2. The dominant land use is the type of industry as much as 86.2 per cent and commerscials as much as 4.4 per cent. It may invite employees working in the industrial sector as well as in the trade and services sectors, which will impact the volume of traffic vehicles passing along the Waru Surabaya-Mojokerto road.

3.3 Land Use Model

The results of modeling land use independent and dependent variables in land use modeling using multiple linear regression analysis along the corridor Waru Surabaya-Mojokerto generate the following data (Table 2).

Variables forming the generation/attraction model of land use movement:

1. Housing : $Y_{Housing}$ = -0,389 + 0,02 (X_1) +0,027(X_3)+0,034 (X_4), which is X_1= building area, X_3= number of household's members, and X_4= number of motorized vehicles possessed by the family, with coefficient of determination = 1.
2. Universities; X_{11}= building area, X_{12}= number of students, with coefficient of determination = 0,994.

Table 2 Land Use Model

Land Use		Trip Generation/Attraction Model	Coefficient of Determination
Settlement/ Housing	Settlement/Housing	$Y_{Housing}$ =-0,389+0,02(X_1)+0,027(X_3)+0,034 (X_4)	1
Education	Elementary School, Yunior High School, Senior High School	$Y_{Education}$ = -0,254+0,141(X_6)+0,112(X_7)-0,024(X_{10})	1
	University/College	$Y_{University}$= -0,355+0,008 (X_{11}) +0,149 (X_{12})	0,994
Office	Offices	$Y_{Offices}$= 0,108+0,662 (X_{15})+0,659 (X_{16})+ 0,000072(X_{18})	1
Health	Hospital	$Y_{Hospital}$= 13,715 + 0,291 (X_{20}) + 0,055 (X_{21})	0,999
	Chemists	$Y_{Chemists}$ = 25,323 + 0,322 (X_{25}) + 0,084 (X_{26})	1
Commercials	Commercials	$Y_{Commercials}$ = -0,431 + 0,075 (X_{29}) + 0,189 (X_{31})	1
	Fuel Station	$Y_{Fuel\ Station}$ = -3,447 + 0,817 (X_{32})	1
Industry	Industry	$Y_{Industry}$= -0,497+0,363 (X_{34})+1,184 (X_{35})	1

3. Offices; X_{15}= number of employees, X_{16}= number of visitors/guests, X_{18}= building area, with coefficient of determination = 1
4. Hospital; X_{20}= number of daily patients, X_{21}= spacious inpatient room, with coefficient of determination = 0,999
5. Chemists; X_{25}= number of customers, X_{26}= building area, with coefficient of determination = 1
6. Commercials; X_{29}= building area, X_{31}= number of visitors, with coefficient of determination = 1
7. Fuel station; X_{32}= number of employees, with coefficient of determination = 1
8. Industries; X_{34}= number of employees, X_{35}= Frequency of delivery of goods, with coefficient of determination = 1

3.4 Generating/Attraction Movement Land Use on Waru Surabaya- Mojokerto Road

Calculation of generation/attraction movement of the 9 types of land use at the average working day is: $Y_{Housing}$= 330 pcu/day, $Y_{Education}$= 1.874 pcu/day, $Y_{University}$= 747 pcu/day, $Y_{Offices}$= 363 pcu/day, $Y_{Hospital}$= 1.365 pcu/day, $Y_{Chemists}$=

243 pcu/day, $Y_{Commercials}$= 4.053 pcu/day, $Y_{Fuel\ Station}$= 3.417 pcu/day and $Y_{Industry}$= 8.882 pcu/day.

Table 3 Generating/Attraction Movement Land Use on Waru Surabaya- Mojokerto Road

Time	Land Use Vehicle Movement Volume (pcu/hour)	Industry Attraction Volume (pcu/hour)	Commercials Attraction Volume (pcu/hour)	Other and Use /olume ıcu/hour)
06-07	491	90	41	361
07-08	896	144	109	643
08-09	1.328	451	277	600
09-10	1.780	812	403	566
10-11	1.952	902	399	650
11-12	2.007	1.014	402	591
12-13	1.590	650	402	539
13-14	1.553	469	388	696
14-15	1.453	290	363	799
15-16	2.101	1.012	274	815
16-17	2.061	1.055	302	703
17-18	1.928	1.000	297	631
18-19	1.302	722	165	416
19-20	831	271	232	329
Total	21.275	8.882	4.053	8.340

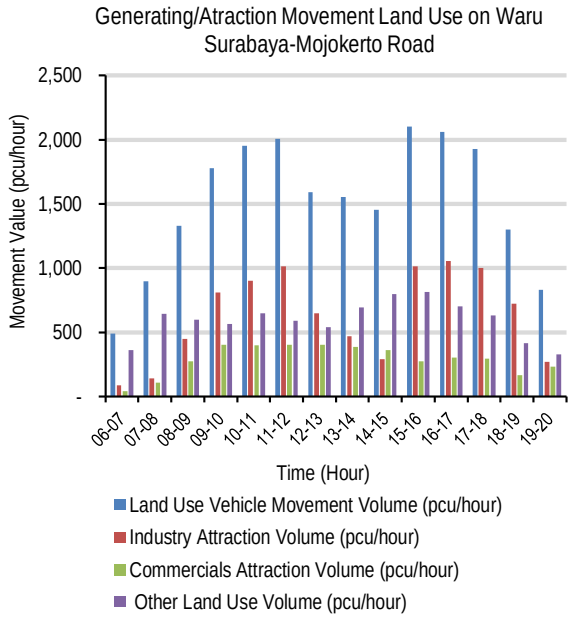

Fig. 3 Generating/Attractive Comparison Chart of Land Use Movements on Waru Surabaya-Mojokerto Road

Total Land Use Movement Volume =21,275 pcu/day.

1. The Effect of Volume of Movements in Industrial Estates Contributes 8,882 pcu/day or 41.72% of Total Land Use Movement Volume (21,275 pcu/day).
2. The Commercials Area contributes to the Movement of Interest Movements 4,053 pcu/day or 19.05% of the Total Movement Volume of Land Use.

3.5 Average Volume of Local & Continuous Vehicle Movement On Waru Surabaya-Mojokerto

The calculation results of daily traffic flow shows the volume of movement of motorcycles 14,532 pcu/day, vehicle type is 31,530 pcu/day and vehicles weigh 9,373 pcu/day, so that the total flow of continuous traffic flow on Waru Surabaya-Mojokerto road is 55. 426 pcu/day. The condition of the peak hour of traffic movement during the hours of 09.00-10.00 with 4,483 pcu/hour and in the afternoon at 16.00-17.00 with 4,713 pcu/hour

While the flow of traffic movement from generated/pulled land use is 21,275 pcu/day, The peak traffic movement condition is afternoon traffic 11.00-12.00 with 2.007 pcu/hour and in the afternoon at 16.00-17.00 with 2,061 pcu/hour.

Table 4 Table of Traffic Flow Volumes on the Waru Surabaya-Mojokerto Road Network

Time	Land Use Vehicle Movement Volume (pcu/hour)	External Volume (pcu/hour)	Total Volume (pcu/hour)
06-07	491	4.276	4.767
07-08	896	4.020	4.916
08-09	1.328	3.907	5.235
09-10	1.780	4.382	6.162
10-11	1.952	4.333	6.285
11-12	2.007	4.284	6.291
12-13	1.590	4.006	5.596
13-14	1.553	3.154	4.707
14-15	1.453	3.216	4.669
15-16	2.101	4.462	6.563
16-17	2.061	4.713	6.774
17-18	1.928	4.399	6.327
18-19	1.302	3.325	4.627
19-20	831	2.947	3.778
Total	21.275	55.424	76.697

1. Continuous Traffic Flow Movement Volume is 55,424 pcu/day or 72% of Total Traffic
2. Movement Volume. Greater when compared to Generating Volume/Attractions from Land Use
3. Volume of Local Traffic Flow from Generating Land Use Interest is 21,275 pcu/day or 28% of Total Traffic Movement Volume

3.6 Level of Services (LOS) of Road Performance in the Waru Surabaya-Mojokerto Road

From the total volume of movement of the traffic flow, both from the flow of continuous traffic (External), and the flow of movement from land use (Internal) compared to the capacity capacity of Waru Surabaya-Mojokerto road to calculate the degree of saturation of the road so that it can be obtained level of service on the road.

1. Movement Volume Total Continuous Traffic Flow is 55,424 pcu/day or 72% of the Total Traffic Movement Volume. Greater when compared with Generating Volume/Attractions from Land Use 21,275 pcu/day or 28%.
2. During rush hours 09.00 to 12.00 and 15.00 to 18.00 the level of poor road service (F) experiences delay and tends to be stalled.
3. The volume of traffic flow movements is on the Waru - Mojokerto road at 09.00 s / d 12.00 and 15.00 s / d 18.00 has exceeded the Road Capacity with F Service Level (vehicle speeds tend to experience delays and lead to congestion).
4. Poor Road Performance Levels due to the high Continuous Flow Volume and also the High Volume of Land Use, especially for Industrial & Trade & Service Areas.
5. In the future, with the start of the functioning of the Surabaya-Kertosono Toll Road, it is expected that there will be a continuous decrease in volume so that Road Performance can reach Ideal conditions.

Table 5. Level of Services of the Waru Surabaya-Mojokerto Road

Time	External Volume (pcu/hour)	Internal Volume (pcu/hour)	Total Volume (pcu/hour)	Roads Capacity	Threshold Capacity C	Degree of Saturation (V/C)	Level of Services (LOC)
06-07	4.276	491	4.767	5.810	4.648	0,82	D
07-08	4.020	896	4.916	5.810	4.648	0,85	D
08-09	3.907	1.328	5.235	5.810	4.648	0,90	E
09-10	4.382	1.780	6.162	5.810	4.648	1,06	F
10-11	4.333	1.952	6.284	5.810	4.648	1,08	F
11-12	4.284	2.007	6.291	5.810	4.648	1,08	F
12-13	4.006	1.590	5.597	5.810	4.648	0,96	E
13-14	3.154	1.553	4.707	5.810	4.648	0,81	D
14-15	3.216	1.453	4.669	5.810	4.648	0,80	D
15-16	4.462	2.101	6.564	5.810	4.648	1,13	F
16-17	4.713	2.061	6.775	5.810	4.648	1,17	F
17-18	4.399	1.928	6.327	5.810	4.648	1,09	F
18-19	3.325	1.302	4.627	5.810	4.648	0,80	C
19-20	2.947	831	3.778	5.810	4.648	0,65	B
Total	55.426	21.275	76.701				

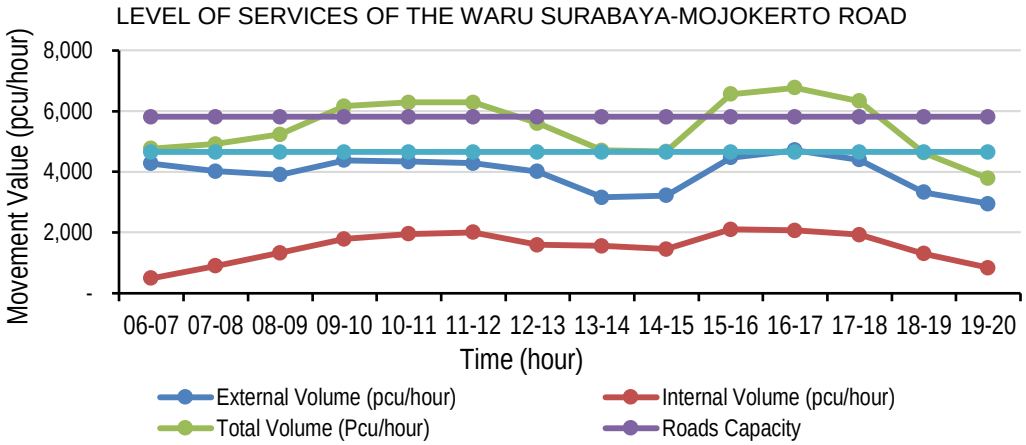

Fig. 5 Level of Services of the Waru Surabaya-Mojokerto Road

4. CONCLUSION

Characteristics of Land Use in the Waru Surabaya-Mojokerto Road corridor currently dominated by industrial estates (86.2 %), trade and services (4.4%), housing (4.4%), education (1.9%), gasoline (1.3%), Offices (0.9%) and Health (0.9%). The tendency of land use conversion from

housing to industry and trade & services must begin to be controlled, because these 2 (two) land uses provide the biggest attraction for generating traffic flow for the internal traffic flow volume.

The tendency of land use conversion from housing to industry and commercials must begin to be controlled, because these 2 (two) land uses provide the biggest attraction for generating traffic flow for the internal traffic flow volume.

The accumulation of the volume of internal movement of volume and the volume of external movement is quite large, making the level of road service in the Waru Surabaya-Mojokerto road corridor worse (F) or likely to experience congestion, especially at the peak hours of the afternoon movement at 09.00 to 12.00 with total the flow of movement is 6,162 pcu/hour up to 6,291 pcu/hour and during the peak hours of the afternoon at 15.00 s / d 18.00 with 6,564 pcu/hour up to 6,327 pcu/hour when compared to the road capacity which is only 5. 810 pcu/ hour. With the functioning of the Surabaya-Mojokerto-Jombang-Kertosono-Nganjuk Toll and so on. we hope that it will reduce the volume of continuous traffic movements, especially for middle-class vehicles (cars, sedans, etc.) that have the opportunity to move through the toll crossroad.

From the actual flow of internal movement volume is the flow of attraction / generation from land use, Industrial Estate (41.72%) or a number of 8,882 pcu/day and commercials (19.05%) or the largest contribution of 4,063 pcu/day. In the future there is a need for government policies to control land use functions that often occur mainly from the use of residential land to Industry and / or Commercials.

5. ACKNOWLEDGEMENT

Thank you to the BPP (Research and Community Services Board), Faculty of Engineering, Brawijaya University who provide funding for this study. Also to the East Java Provincial Center for Roads & Bridges who provided secondary data in this study.

6. REFERENCES

[1] Cervero R. L. and-Use Mixing and Suburban Mobility. Transportation Quarterly, 42(3), 1988, pp. 429-446.

[2] Cervero R., Mixed land-uses and Commuting: Evidence from the American Housing Survey. Transportation Research Part A: Policy and Practice, 30(5), 1996, pp. 251-260.

[3] Breheny M. The Compact City and Transport Energy Consumption. Transactions of the Insitute of British Geograpehers,1995, pp. 81-101.

[4] Waloejo B.S., Road Network – Land Use Interaction Model: Malang City in Indonesian Case. IOP Conference Series: Earth and Environmental Science, DOI:10.1088/ISSN.1755-1315, Oneline ISSN: 1755-1315, Print ISSN:1755-1307, 2017, pp. 38-44.

[5] Waloejo B.S., Surjono & Sulistio H. The Influence of Trip Attraction on the Road's Level of Service (LOS) at Traditional Market Land Use. Journal of Applied Environmental and Biological Sciences (JAEBS), 2012, pp. 92-96.

[6] Sugiyono. Statistics for Research. Bandung: Publisher Alfabeta Bandung, 2010, pp. 68-70.

[7] Imma W.A, Waloejo B.S. Trip Attraction Model of Land Use for Industrial Area. Regional Conference in Civil Engineering (RCCE), The Third International Conference on Civil Engineering Research (ICCER), August 1 st -2 nd 2017, Surabaya-Indonesia, 2017, pp. 277-283.

[8] Andrianto,The Effect of Land Use Development on the Performance of Primary Arterial Roads in Sidoarjo Regency. Thesis Unpublished Universitas Gadjah Mada, 2014, pp. 86-92.

[9] Guenter E, Paul C. Pfaffenbicher and Sittha J., Application of European Land Use-Transport Interaction Model MARS to Asian Cities. Vienna: Institute for Transport Planning and Traffic Engineering Vienna University of Technology,2003, pp. 134-144.

[10] Ward M., Dixon J., Sadler B. and Wilson J., Integrating Land Use and Transport Planning. Land Transport New Zealand Research Report 333. 116pp. Waterloo Quay, Wellington, New Zealand, 2007, pp. 232-245.

[11] Krizek K. And Levinson D., Teaching Integrated Land Use Transportation Planning: Topic, Reading and Strategies. Jurnal of Planning Education and Research 24(3), 2005, pp. 304-306.

[12] Hanum H., Comparison of Stepwise Method, Best Subset Regression, and Fraction in Selection of the Best Multiple Regression Model. Journal of Science Research: 14 (2A) 14201, 2011, pp. 1-6.

[13] Tamin O., Transport Model and Planning. Bandung: ITB, 2000, pp. 124-130

[14] Waloejo B.S., Interaction Model for Land Use and Road Networks. Dissertation. Unpublished Brawijaya University, 2013,pp. 53-55.