Influence of Residential Area Movement on the Performance of Kranggan Cibubur Road Section

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| Submitted: August 25, 2023 | Revised: December 23, 2023 | Accepted: September 28, 2024 |

| Published: December 31, 2024 |

ABSTRACT

The population of Bekasi and Depok City continues to increase, so the need for housing will also increase. To fulfill the need for housing, settlements will continue to develop. With the continued development of settlements, the volume of surrounding traffic will also increase. When the increase in traffic volume is not balanced with an increase in the capacity of the road section, there will be long queues of vehicles and long travel times. The purpose of this study is to determine the generation of movements generated from settlements. The results of this study are the estimation of movement generation from Kranggan Permai housing with a linear regression equation model, namely multiple $Y_1 = -0.007 + 0.011X_1 + 0.649X_4 + 0.118X_5 + 0.336X_7$ with a generation value of 512.94 and Cibubur housing with a regression equation model, namely $Y_2 = 0.929 + 0.530X_4 + 0.388X_6 + 0.423X_7$ with a generation value of 603.043 smp/hour.

Keywords: trip generation; trip production; multiple regression.

INTRODUCTION

One of the areas in Bekasi City that has developed into a residential area is the Kranggan-Cibubur area. There are housing complexes around the Kranggan road. Kranggan-Cibubur Road is located in a strategic area, namely between the Jagorawi toll road, the Transyogi toll road (Cibubur Jonggol) and the Bogor highway. The number of residents and the number of vehicles always increases every year. The population of Bekasi City in 2015 based on the results of a population survey was 2,733,240 people. Housing on the Kranggan - Cibubur road section produces a movement generation that causes an increase in traffic volume. Especially during the morning and evening rush hours. This increase in traffic volume is not in line with the capacity of the road section. So it is necessary to analyze to determine the resulting movement generation.

Traffic generation theory is a branch of transportation planning that studies how an activity or location generates trips. This theory focuses on the process of how and why people initiate trips from one point to another. Under normal traffic conditions, trip generation is closely related to the social, economic, and geographic factors of an area. Trip generation is the first step in the four-stage transportation planning process, which includes: Trip Generation, Trip Distribution, Mode Choice, Route Assignment, in the generation stage, the number of trips departing from a zone (origin zone) and the number of trips arriving at that zone (destination zone) are analyzed. This analysis is based on various factors such as population, income level, housing density, and availability of public facilities (Panjaitan H et.al, 2024; Gusty S et.al, 2024).

Under normal traffic conditions, trip generation tends to be stable and can be predicted with considerable accuracy. Daily trip patterns, such as home-to-work trips, home-to-school trips, and trips for recreation or shopping, show high consistency. Trip Generation Model, some models that are often used to estimate trip generation include: Linear Regression Model, this model uses independent variables such as population and vehicle ownership rates to predict the number of trips generated. Category Model (Cross-Classification), this model groups zones based on certain characteristics such as income and housing type, then estimates trip generation for each group (Sugesti BG et.al, 2024; Akbardin J et.al, 2024).

pISSN 2302-4240
eISSN 2655-2086

Volume 14, Issue 1, February 2025, pp.014-019
DOI: http://dx.doi.org/10.32832/astonjadro.v14i1 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

Econometric Model, this model is more complex and involves mathematical relationships between various economic and demographic variables and the number of trips. Application in Transportation Planning, trip generation theory plays an important role in determining future transportation infrastructure needs. By understanding and predicting trip generation, planners can design road and public transportation systems that are in accordance with community needs. Under normal traffic conditions, historical data is used as a basis for planning and evaluation. An example of the application of this theory is in planning the construction of a new shopping center. Trip generation analysis helps determine the number of parking spaces needed and the potential impact on surrounding traffic. In addition, local governments also use this theory to determine the location of new schools and hospitals to reduce congestion and improve accessibility (Syaiful S et.al, 2023; Syaiful S et.al, 2024).

Traffic Generation

The number of trips/movements/transfers/traffic that experiences a revival by a region (zone) per unit of time is the definition of movement generation (Miro, 2005). This movement generation aims to determine the number of movements that experience a revival caused by the area of origin (Oi) and the number of movements attracted to the destination area (Dd) located in the area being studied. The areas of origin and destination of movement are often referred to as trip ends (Tamin, 2000). According to Tamin (2000), the factors that influence movement generation are as follows:

1. Movement generation for humans
2. Income
3. Vehicle ownership
4. Household structure and size
5. Land value
6. Density of residential areas
7. Accessibility
8. Movementpull for humans
9. Movement generation and pull for goods

Linear Regression Analysis Model

Linear regression analysis is a statistical method used to study the relationship between properties and the problem being studied. Cases that have more independent variables and parameters. This is needed to prove that changes in land use can simultaneously affect movement generation. The general equation of multiple linear regression analysis (Tamin, 2000). $Y = b_0 + b_1 X_1 + b_2 X_2 + \ldots + b_z X_z$

where:

Y	= dependent variable
$X_1 – X_2$	= independent variable
b_0	= regression constant
b_1-b_2	= regression coefficient

RESEARCH METHODS

Description of Time and Location

This research started from February 2023 to December 2023. This research was conducted in the Kranggan Permai and Cibubur housing estates.

Data Collection

Data collection was carried out by filling out a questionnaire.

Processing with Data Analysis

Data processing and analysis were processed using multiple linear regression analysis, the results obtained were a trip generation model. From this model, it can be estimated for the amount of generation that occurred in the observation year (2023) and the prediction year (2028).

RESULTS AND DISCUSSION

Trip Generation Data

In this study, the samples obtained were 92 samples. Namely 39 samples from the Kranggan Permai housing estate and 53 samples from the Cibubur housing estate. For the modeling of this movement generation, it is carried out individually in each housing, so for the dependent variables, they are as follows:

Y_1 = Kranggan housing movement generation
Y_2 = Cibubur housing movement generation
While for the independent variables, they are
X_1 = Age
X_2 = Education
X_3 = Occupation
X_4 = Income/month (rupiah)
X_5 = Number of family members
X_6 = Number of working families
X_7 = Number of motorbikes
X_8 = Number of cars

To obtain a model that best describes the influence of the independent variables on the dependent variable, multiple linear regression analysis is used.

Kranggan Housing

In Kranggan housing, by analyzing step by step, the best model is sought using 8 variables. To obtain a model that best describes the influence of the independent variables on the dependent variable, regression is carried out again by eliminating independent variables that do not meet the requirements so that only 4 variables are used, as follows:

Table 1. Calculation of multiple linear regression analysis of Kranggan housing 4 variables

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-0.01	0.61	-0.01	0.99	-1.26	1.24	-1.26	1.24
X_1	0.01	0.01	1.07	0.29	-0.01	0.03	-0.01	0.03
X_4	0.65	0.12	5.37	0.00	0.40	0.89	0.40	0.89
X_5	0.12	0.08	1.42	0.16	-0.05	0.29	-0.05	0.29
X_7	0.34	0.18	1.86	0.07	-0.03	0.70	-0.03	0.70

Source: Analysis results, 2023

With an R2 value of 0.667, the movement generation model for Kranggan housing is $Y_1 = -0.007 + 0.011\ X_1 + 0.649\ X_4 + 0.118\ X_5 + 0.336\ X_7$ from this equation it can be seen that the amount of generation generated from Kranggan housing is 512.94 vehicles/hour.

Cibubur Housing

For Cibubur housing, by analyzing step by step, the best model is sought using 8 variables. To obtain a model that best describes the effect of the independent variables on the dependent variable, regression is carried out again by eliminating independent variables that do not meet the requirements so that only 3 variables are used, namely as follows:

Table 2. Multiple linear regression analysis of Cibubur housing 3 variables

	Coefficients	Standard	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%

pISSN 2302-4240
eISSN 2655-2086

Volume 14, Issue 1, February 2025, pp.014-019
DOI: http://dx.doi.org/10.32832/astonjadro.v14i1 http://ejournal.uika-bogor.ac.id/index.php/ASTONJADRO

		Error						
Intercept	0.93	0.33	2.84	0.01	0.27	1.59	0.27	1.59
X_4	0.53	0.11	4.83	0.00	0.31	0.75	0.31	0.75
X_6	0.39	0.14	2.74	0.01	0.10	0.67	0.10	0.67
X_7	0.42	0.17	2.52	0.01	0.09	0.76	0.09	0.76

Source: Analysis results, 2023

With an R2 value of 0.590, the movement generation model for Kranggan housing is $Y_2 = 0.93 + 0.53\ X_4 + 0.39\ X_6 + 0.42\ X_7$ from this equation, it can be seen that the amount of generation generated from Kranggan housing is 90,103 vehicles/hour.

Table 3. Summary of Generation Model Analysis Results for Each Housing in 2023

Housing	Movement Generation Model	Model Result Estimation (vehicles/hour)
Kranggan	$Y_1 = -0.007 + 0.011\ X_1 + 0.649\ X_4 + 0.118\ X_5 + 0.336\ X_7$	512.94
Cibubur	$Y_2 = 0.929 + 0.530\ X_4 + 0.388\ X_6 + 0.423\ X_7$	90.10
	Amount	603.04

Source: Analysis results, 2023

Based on data from the survey results, the amount of each selected free parameter component that affects the trip generation in 2023 and the prediction for 2028 in Kranggan housing can be seen in Table 4:

Table 4. Growth in Kranggan housing in 2028

Variable	Years 2023	Growth	Years 2028
X_1 (Age)	68	0.0178	74
X_4 (Income/month)	4	0.0294	5
X_5 (Number of families)	174	0.0199	192
X_7 (Number of motorcycles)	92	0.0183	101

Source: Analysis results, 2023

Table 5. Housing Growth in Kranggan 2028

Variable	Years 2023	Growth	Years 2028
X_4 (Income/month)	4	0.0513	5
X_6 (Number of workers)	87	0.0077	90
X_7 (Number of motorcycles)	126	0.0691	176

Source: Analysis results, 2023

Table 6. Number of trips made in 2023 and 2028

	Years 2023	Years 2028	Description
Number of trips	603.043	678.01	Travel/hour

Source: Analysis results, 2023

CONCLUSION

The movement generation model generated from Kranggan housing is $Y_1 = -0.007 + 0.011\ X_1 + 0.649\ X_4 + 0.118\ X_5 + 0.336\ X_7$ with a movement generation value of 512.94 vehicles/hour. and for the Cibubur housing generation model, namely $Y_2 = 0.929 + 0.530\ X_4 + 0.388\ X_6 + 0.423\ X_7$ with a movement generation value of 90,103 vehicles/hour. So that the total housing movement generation is 603,043vehicles/hour. The predicted trips that will occur in 2028 are around 678.01 vehicles/hour.

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Volume 14, Issue 1, February 2025, pp.014-019
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