E16_Geometric Redesign of Road Parongpong-Ngamprah STA. 0+750-1+500 Based on Atraction-Generation Interzone Movement

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Abstract

The increase in movement between zones between sub-districts in the Regency increases in line with economic development in the region. Parongpon sub-district and Ngamprah sub-district are West Bandung regency areas that have increased economic growth which is quite significant in West Bandung Regency. The geometric redesign research between Parongpong and Ngamprah zones has the aim of adjusting the road geometry based on increasing the volume generation and attraction of traffic movement between these zones. The generation and attraction of traffic movement between these zones is dominated by the volume of vehicles with larger dimensions and heavier loads, so that geometric alignment of the road is required based on the standard slope of the vertical alignment and the super-elevation curve of the horizontal alignment. The research method used is quantitative descriptive in geometric design parameters which are developed in accordance with the development of traffic volume and vehicle types. The research results show the Rise and Attract model of movement between Parongpong-Ngamprah zones with the mathematical model shown by the equation $Y = 28.064 + 0.0003612X_1 + 0.001X_2 + 0.005X_3$ with $R^2 = 0.97$. With the influence of the generation of traffic volume movement on these roads, of requires adjustment of the super evaluation curve with a larger radius and smaller vertical alignment slope so that the increase in traffic volume from the influence of the generation and attraction of the movement of the Parongpong-Ngamprah zone can be anticipated with fine.

***Keywords**: Geometric Redesign, Parongpong-Ngamprah Road, Atrction-Generating Inter Zone.*

A. INTRODUCTION

The Parongpong-Ngamprah Road Section is a road section that connects zones that have high traffic growth. The traffic volume on this section has a fairly high v/c ratio, which is above 0.75. This route is the volume of traffic going to tourist areas that doesn't need to enter the city of Bandung first, therefore the role of this road segment is very important in unraveling congestion in the city of Bandung. However, in fact, as reported by the National Transportation Safety Committee in 2016, there was a series of collisions by buses which resulted in 9 people dying, 7 people being seriously injured and 23 people suffering minor injuries (Akbardin et al., 2018).

From the above review, it indicates that the Paropong-Ngamprah road network system needs a geometric improvement. To optimize the live function as a primary collector road network system, a study is needed to provide the best solution in improving the network system. By the analysis of the existing conditions, it can be formulated how much trip generation is generated from the Parongpong sub-district to the Ngamprah area. So that the performance of these roads can be known the level of service. Therefore, the geometric effectiveness of the vertical and horizontal alignment of the road can be adjusted to the increase in traffic volume due to the development of the zone (Akbardin et al., 2017).

In this study, the research objectives were determined as follows: to analyze to formulate a model of movement generation from the Parongpong sub-district to the Ngamprah area, to analyze and design a new geometric design based on the traffic volume factor due to the growth in traffic volume (Williams et al., 2013).

B. LITERATURE REVIEW

1. Transportation System

The system is a number of components or objects that are interrelated. While the transportation system is a system of movement of people and/goods from a zone of origin to a destination zone in the area concerned. The movement in question can be carried out using various sources of power, and is carried out for a particular purpose (Tamin, 2000)

2. Trip Generation and Attraction of Movement

Attraction and generation is the amount of movement attracted to a land use or movement attraction zone. Traffic movement is a land use function that generates traffic flow. The result of a traffic pull calculation is the number of vehicles, people or goods transported per unit time.

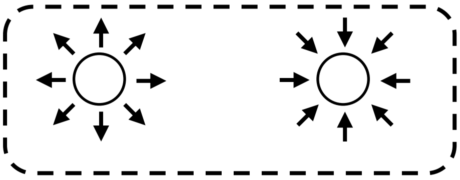

Figure 1. Trip Genertion and Trip Atraction

Traffic generation and attraction depend on two aspects of land use the type of land use (type of land user) and the amount of activity and intensity of land use. Different types of land use (residential, educational, and commercial) have different traffic generation characteristics, namely: Number of traffic flows, Type of traffic (pedestrian, truck, or car), and Traffic at certain times (offices generate morning and evening traffic, shops generate traffic flow throughout the day.

3. Trip Generation Model

The movement generation modeling phase aims to obtain the number of movements generated by each origin zone (Oi) and the number of movements attracted to each destination zone (D4) in each area to be studied. The zone of origin and destination zone of movement usually also use the term Trip End. This model is needed when the effects of land use and ownership of movements on the magnitude of the generation and attraction of movements change as a function of time. This stage of movement generation predicts the number of moves a person will make in each zone of origin using detailed level data movement generation, socio-economic attributes, and land use.

4. Multiple Linear Regression

This concept is a further development of the description above, especially in cases where there are more independent variables and parameter bˆ This is very necessary in reality which shows that several land use variables simultaneously affect the generation of movement. Equation (1) shows the general form of the multiple-linear-regression analysis method.

$$Y = A + B1X1 + B2X2 + \dots + BnXn \quad (1)$$

With:

Y = Change is not free

X1...Xz = Independent variable

A = Regression constant

B1…Bz = Regression coefficient

Multiple linear-regression analysis is a statistical method. To use it, there are several assumptions that must be considered:

Variable value. In particular, independent variables have a certain value or are a certain value or are values obtained from survey results without significant errors.

The dependent variable (Y) must have a linear correlation with the independent variable (X). if the relationship is not linear. A linear transformation must be performed. Although this limitation will have other implications in residual analysis;

The effect of the independent variables on the dependent variables is a sum, and there must be no strong correlation between the independent variables;

a. The variance of dependent variables on the regression line must be the same for all independent variable values;
b. The values of dependent variables must be normally distributed or at least close to normal;
c. The value of the independent variable should be a quantity that is relatively easy to project.

The solution remains the same, but more complex so some new things have to be considered as follows.

a. Multicollinearity

   This happens because there is a linear relationship between variables; In this case, the several equations containing bˆ are not independent and cannot be uniquely solved.
b. The number of parameters 'b' required to decide on this, several factors must be considered:
   1). Is there a strong theoretical reason to be involved with that variable or is that variable important for the test process with the model?
   2). Is the variable significant and is the sign of the parameter coefficient that is obtained in accordance with theory or intuition? If in doubt, apply one method, namely eliminating the variable and carrying out the regression

process again to see the effect of removing the variable on other variables that are still used by the model. If it is not too affected, the variable is discarded so that we get a model that is simpler and can be estimated more precisely (Veras et al., 2012).

d. The coefficient of determination

The form is the same as equation (2). However, in this case, the addition of b̂ usually increases the value of R^2; to overcome this, the corrected R^2 value is used:

$$\bar{R}2 = \left[\boldsymbol{R^2} - \frac{\boldsymbol{K}}{\boldsymbol{N-1}}\right]\left[\frac{\boldsymbol{N-1}}{\boldsymbol{N-K-1}}\right] \quad (2)$$

e. Correlation coefficient

This correlation coefficient is used to determine the correlation between dependent variables and independent variables or between independent variables. To calculate the correlation coefficient can be done in various ways, one of which is as follows:

$$\boldsymbol{r} = \frac{N\sum_i(XiYi) - \sum_i(Xi)\sum_i Yi}{\sqrt{[N\sum_i(X_i^2) - (\sum_i(X_i))^2][N\sum_i(Y_i^2) - (\sum_i(Y_i))^2]}} \quad (3)$$

The value of r = 1 means that the correlation between the variables y and x is positive (an increase in the value of x will result in an increase in the value of y). Conversely, if the value of r = −1, it means that the correlation between the variables y and x is negative (an increase in the value of x will result in a decrease in the value of y). The value of r = 0 indicates that there is no correlation between variables. In motion generation modeling, the method of multiple-linear-regression analysis has been used; both with zone data (aggregate) and household or individual data (non-aggregate).

C. MATERIAL AND METHODS

The data taken from this study are primary and secondary data. Primary data obtained through the survey method. The primary data type identified is the geometric of the existing road. Secondary data was obtained from several related agencies and the validity of the data can be accounted for the data is as follows shown table 1:

Table 1. Variable Data

No	Variable Data	Source
1	Total Population	National statistics agency
2	District GDP	National statistics agency
3	Number of work-force	National statistics agency

D. RESULT AND DISCUSSION

In this chapter, we will discuss generation and attraction modeling using multiple linear regression analysis to be able to determine the growth of Parongpog road traffic in the planned year, namely in 2051. From the data generated from modeling generation and attraction will be used to carry out an operational analysis of the road according to Indonesian Road Capacity Manual (MKJI), this analysis is needed to be able to determine the capacity and performance of the Colonel Masturi Road. Furthermore, an evaluation and geometric improvement of the Parongpong-Ngamprah was also carried out.

Data collection

The data used in the modeling of rise and pull is secondary data. Secondary data is the type of data in research based on how to obtain it, which means that the source of research data is obtained and collected by researchers indirectly but with other parties whose data can be accounted for.

Independent Variable Data

The independent variables in this study are; population, total workforce, and gross regional income. The data was obtained from the Central Bureau of Statistics of West Java Province and the timeframe for the data used is the last 10 years:

Generation Model Analysis

The data that has been collected is then analyzed using the multiple linear regression method with the help of SPSS software. Multiple linear regression analysis is used to determine the effect of two or more independent variables (X) on the dependent variable (Y) which is then used to estimate the number of generations in Parongpong-Ngamprah up to the planned year, namely with predetermined independent variables. Generation model analysis with multiple linear regression method indicated by the model

1. **Modelling of Trip Generation and Trip Atraction**

Modeling requires data for Parongpong-Ngamprah generation model analysis using multiple linear regression methods. The self-generated model consists of the analysis of Average Daily Traffic (Y) generation. Multiple Linear Regression Classical Assumptions Test

The Normality Test is carried out to test whether in a regression model, an independent variable and a dependent variable or both have a normal or abnormal distribution. If a variable is not normally distributed, the statistical test results will decrease. In the data normality test, it can be done with the One Sample Kolmogorov Smirnov test, namely with the provision that if the significance value is above 5% or 0.05, the data

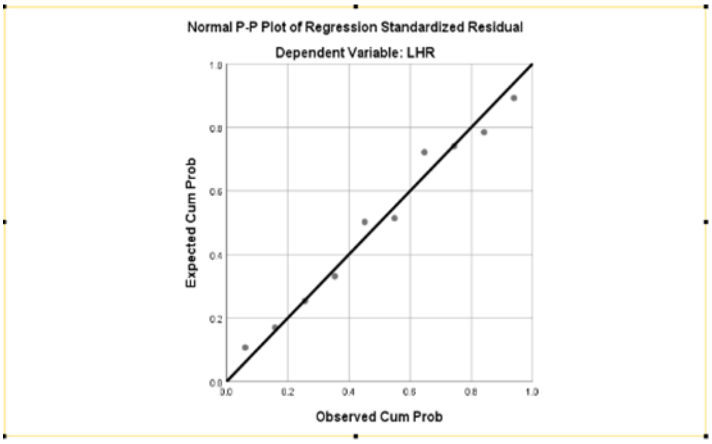

Figure 2. Normality Test

Table 2. Analysis of Coefficient Model

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	28.064	84.026		.334	.750		
	PDRB	3.612E-5	.000	.475	4.855	.003	.381	2.624
	PENDUDUK	.001	.000	.288	3.062	.022	.412	2.430
	TENAGA KERJA	.005	.001	.341	3.953	.008	.490	2.043

a. Dependent Variable: LHR

It can be seen from the output results of the multicollinearity test that the Tolerance value is greater than 0.100 and the VIF value is less than 10. So, it can be concluded that the regression model does not have symptoms of multicollinearity so that these variables can be used for testing

Table 3. Analysis of Varian

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	91574.511	3	30524.837	89.259	.000[b]
	Residual	2051.877	6	341.980		
	Total	93626.388	9			

a. Dependent Variable: LHR

b. Predictors: (Constant), TENAGA KERJA, PENDUDUK, PDRB

It can be seen from the results of the simultaneous f test output sig. smaller than 0.05. So, it can be concluded that the independent variable (X) has a simultaneous effect on the dependent variable (Y).

Table 4. T test Analysis

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.	Collinearity Statistics Tolerance	Collinearity Statistics VIF
1	(Constant)	28.046	84.023		.334	.750		
	PDRB	4.017E-5	.000	.475	4.855	.003	.381	2.624
	PENDUDUK	.001	.000	.288	3.062	.022	.412	2.430
	TENAGA KERJA	.006	.002	.341	3.953	.008	.490	2.043

a. Dependent Variable: LHR

It can be seen from the partial T test output of the value of Sig. smaller than 0.05. it can be concluded that the independent variable (X) has an independent effect on the dependent variable (Y)

2. Degree Saturation of Road Parongpong-Ngamprah

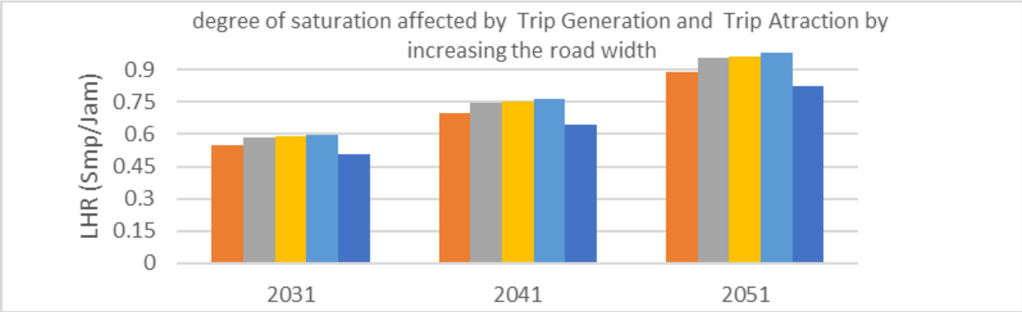

Figure 3. Degree of Saturation Affected by Trip Generation and Trip Atraction Increasing without The Road Width

The degree of saturation on the road section shows a high degree of saturation, so it is necessary to increase the ROW of the road by adjusting the width of the road to reduce the road increase. (Gerlough, 1976). The decrease in the degree of saturation of the road after increasing the road width is shown in Figure 5. So that it affects the geometric design of the Parongpong Ngamprah road section (Julianto, 2010).

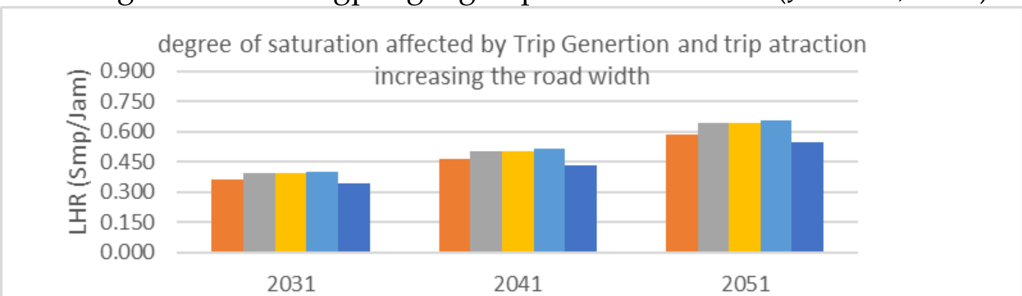

Figure 4. Degree of Saturation Affected by Trip Genertion and Trip Atraction Increasing the Road Width

3. Geometric Redesign Due to Increased Traffic Volume from the Effects Of Trip Generation and Trip Attraction

Figure 5. Condition Existing of Parongpong-Ngamprah Road

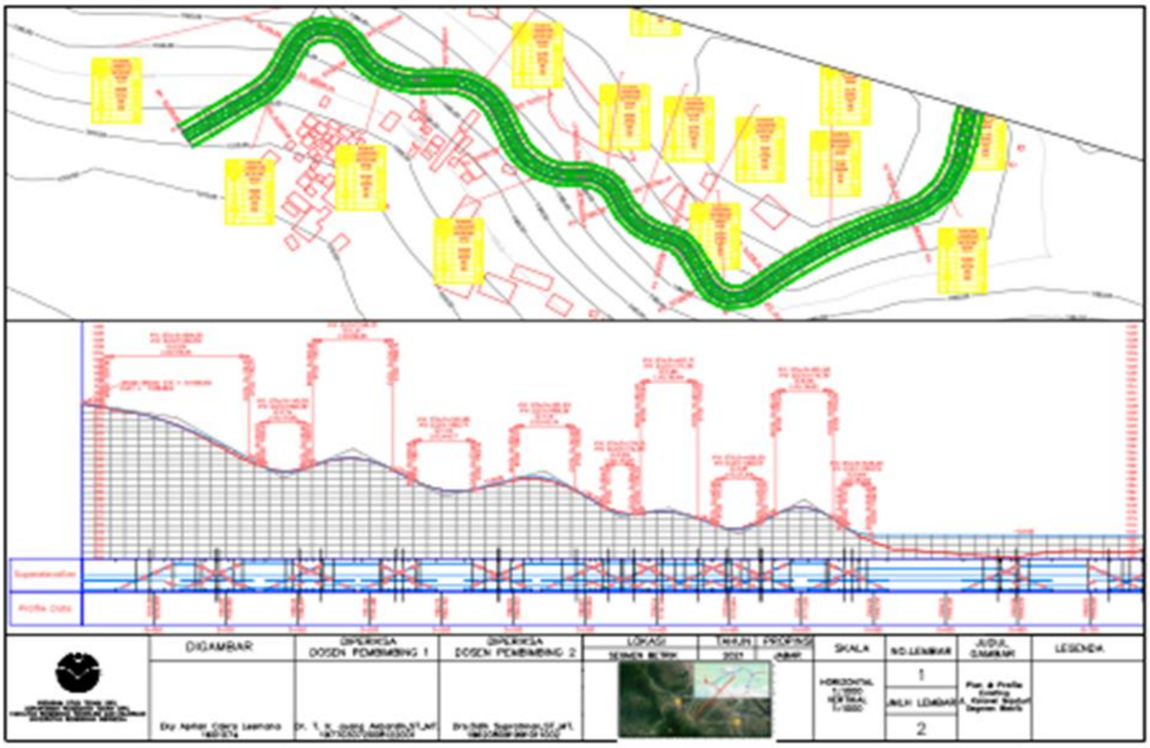

Figure 6. Results of Geometric Design Analysis Due to The Influence of Trip Generation and Trip Attraction

The maximum slope allowed for Vr = 30 km/h is ±10%, so g for vertical alignment is not in accordance with the requirements (Suryadarma, 2008). While the vertical curve for speeds below <40 km/h is 20-40 m.

Control: Lvmax ≥ Lvdesign ≥ Lvmin 40 m ≥ 32.85 ≥ 20 m …… As Requirements

To be able to evaluate the degree of curvature, we must first determine the maximum permissible degree of curvature. The maximum degree of curvature can be determined by the following formula:

$$Dmax = \frac{181913.53x(emax - fmax)}{Vr^2} \quad (4)$$

The Parongpong-Ngamprah terrain is classified as a mountainous terrain, so the recommended design speed (Vr) is 30 km/hour and the type of bend used is the type of bend without transitional curves or Full Circle (Pignataro, 1972). The recommended Rmin for this type of bend without a transition curve is 130 meters. Meanwhile, the emax used is 10% (Oglesby, 1982)

Based on the evaluation results above, there are several geometric parameters that do not meet the requirements. Therefore, it is necessary to carry out geometric repairs and redesigns for Parongpong-Ngamprah so that it complies with safe and comfortable conditions so that the road path is in accordance with the design standards of the volume change (Agah & Siregar, 2003).

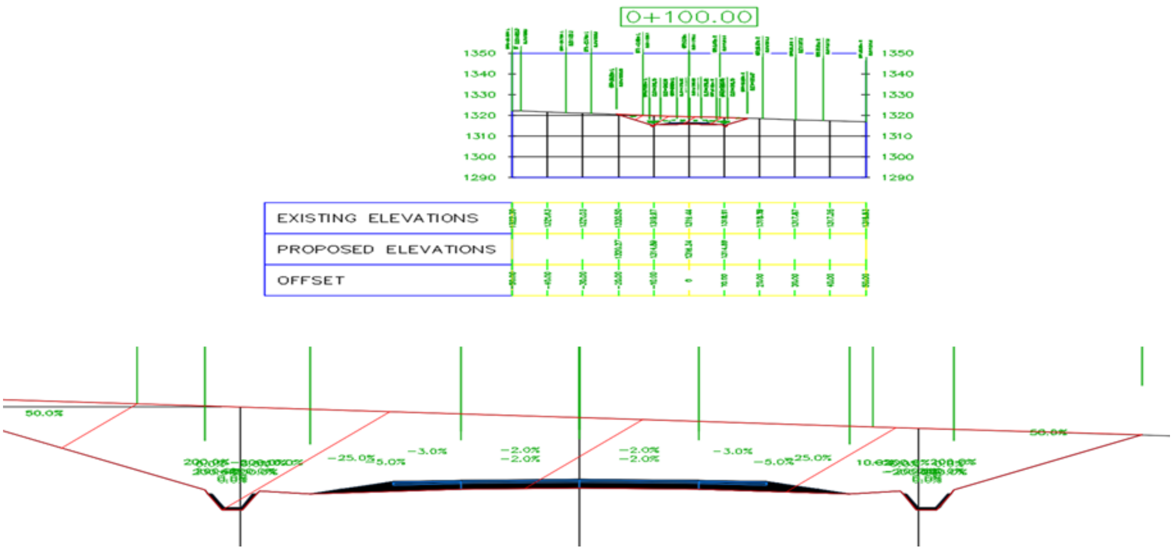

Figure 7. Crosssection of Parongpong-Ngamprah Roads after ROW Development

E. CONCLUSIONS

The resulting model of trip generation and trip attraction is Y = 28.064 + 0.00003612 X1 + 0.001 X2 + 0.005 X3 with the determination test R2 = 97.8% indicating that the geometric redign of the road must always be evaluated because the increase in traffic volume greatly affects geometric design parameters, especially in vertical alignment and horizontal alignment. So that with a periodic geometric redesign according to the service life, it will increase the comfort and safety of riders and expedite traffic flow on inter-zone connections.

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