Analysis Of The Needs Of Road Network Development Ini Baturaja City, Indonesia Using Macro Simulation Model

Paramitha Syafarina, Joni Arliansyah, Erika Buchari

Abstract: Baturaja City is the capital of Ogan Komering Ulu Regency in South Sumatra Province. The transportation modeling study of Baturaja City was conducted by using the Visum Program of macrosimulation program to disclose the pattern of travel movements in Baturaja City and to find out the traffic loading as a reference for the development of further transportation infrastructure. In addition, alternative route choices with relatively closer distance and shorter travel time are also obtained. In this study, Baturaja City's transportation model was modeled by using the Visum Program, whose modeling was based on a four-stage transportation model. The model reliability test resulted in the determinant coefficient (R^2) of 0.965. This result stated that the result of the volume of traffic loading that was modeled using the Visum Program resembled the volume of loading of existing traffic conditions in the field. Then, after loading analysis with the Visum Program on several road sections and on the 5 existing bridges, it was found that the value of the degree of saturation obtained was not more than 1 for each road segment and bridge both in the existing condition and after the additional bridge was constructed which meant that the road sections and bridges were still able to accommodate the existing traffic load. In addition, with the construction of 2 additional bridges, there is a change in the flow of the 4 existing bridges. That means the construction of this additional bridge helps spread the traffic volume on existing bridges to the new bridges so that it helps reduce the traffic load and this greatly affects the condition of the traffic in Baturaja City.

Index Terms: Transport Modelling, Visum, Trip Assignment

1 INTRODUCTION

Transportation is a very important need at present. The function of transportation has an important role in the economic development of a nation. One function of transportation is to move passengers or goods from one place to the destination. Besides that transportation also facilitates access and mobility of the transfer of goods or passenger transportation. According to Tamin there are several roles of transportation planning and modeling, namely to ensure that the need for movement in the form of movement carried out by humans, movement of goods carried out by humans, or movement of vehicles that can be supported properly by existing transportation infrastructure systems [1]. At this time the need for transportation to make movements is very high. Therefore, the high level of demand and the use of a mode or vehicle can cause the most basic problem of the poor transportation system in Indonesia, namely congestion. To get a good transportation system, a good transportation model is needed. Transportation modeling is made to predict the condition of road network at the study area and to analyze its adequacy for the traffic load that can be accommodated by the road and bridge network. The expected transportation model can be used as a reference for estimating the movement needs of travel, whether it is the movement of people, goods or vehicles, the need for a good network system, and transportation policies that will be planned in the future. According to Robineau, transportation modeling is a supporting tool in making a decision. In addition, it is also a tool to assess the impact of the construction of infrastructure projects and others. According to him there are three types of transportation sub-models, namely demand models, network models, different models of impact and assignment [2]. Transportation problems, such as traffic jams and chaotic traffic networks are not only experienced by big cities but also occur in small cities like Baturaja City. In this study, transportation modeling was conducted for Baturaja City by using the macrosimulation program Visum Program. This study was conducted in Baturaja City to predict the condition of the transportation system of the city's traffic network at present and in the future. In addition, it is also intended to analyze the adequacy of road and bridge capacity with the traffic load of a road network in accordance with the real condition in the field.

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2 MATERIAL AND METHOD

2.1 PRIMARY AND SECONDARY DATA OF THE STUDY

2.1.1 PRIMARY DATA

In this study two surveys were conducted to obtain the primary data. The surveys were Origin Destination Survey or abbreviated as OD survey with the home interview method of household surveys or interviews and survey traffic counts. The OD survey was aimed not only to obtain matrix OD information, but also to obtain some other data including ownership of the respondent's vehicles, the respondent's income, the respondent's employment, and others. While the Traffic count survey was carried out to

get the traffic volume according to the existing conditions in the field. The Origin-Destination Survey produced the data on the Origin-Destination Matrix (OD-M). After the matrix OD data were obtained, modeling can be done with the Visum Program. The population of the city of Baturaja, the study area, in 2018 was in the range of 50,000 - 150,000, namely 135,888 people [9], [10]. So if a sample of 12.5% was taken, the recommended sample size was 135,888 x 12.5% = 16,986 inhabitants, and if a sample consisted of 5%, the minimum sample size was 135,888 x 5% = 6,794.4 people. The sample of the respondents taken was 5%, numbering 6,794.4 people or 1,359 households. The number of samples was divided into 25 villages or as many as 55 respondents per village. Whereas the Traffic count survey was carried out in several road segments that were studied.

2.1.2 SECONDARY DATA

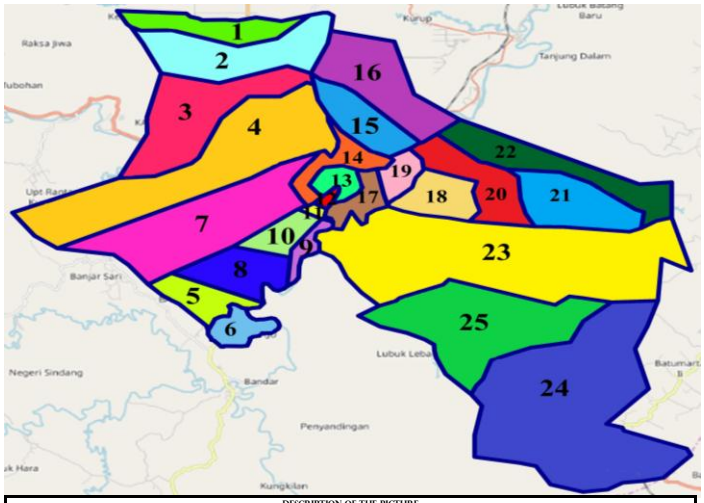
The secondary data were obtained from several relevant agencies from several sources that includes:

1. The researches conducted earlier.
2. The data issued by relevant agencies, including:
   - East Baturaja Subdistrict in Figures
   - West Baturaja Subdistrict in Figures
   - Map of the Oku Regency's road network
   - Map of the Oku Regency's Road Sections
   - Map of Road Sections in the City of Baturaja

2.2 TRAFFIC MODELING USING VISUM PROGRAM

Transportation model of Baturaja City was developed by using the macrosimulation program of Visum Program. The Visum Program is a transportation modeling software used for predicting and analyzing traffic, predicting and GIS-based data management. Transportation experts use this program to model transportation networks and its travel requests, and analyze traffic flows and plan transportation systems etc. [8]. Several studies have used this Visum Program to make a transportation model [2][3][4][5][6]. The transportation modeling with Visum Program can be explained in more detailed in the following steps [4][7]:

1. The first step is click on the Visum Program. Then input *OpenStreetMap* based *Background Maps*.
2. After the OpenStreetMap map has appeared, the next step is to create a base map for the road network in accordance with the study area and validate the base map by drawing the road network in accordance with the existing road network in the existing condition by making a point or nodes. After the nodes are created, the nodes then are linked with a *link* so that the road network is connected to each other.
3. After validating by confirming each link and nodes are connected and in accordance with the existing conditions in the field, meaning that the model can be run as desired.
4. The next step is the depiction and division of zones. And dividing the analysis zones of the city of Baturaja in accordance with the study needs. The division of zone analysis can be seen in Figure 1.



DESCRIPTION OF THE PICTURE

ZONE	NAME OF THE VILLAGE	ZONE	NAME OF THE VILLAGE	ZONE	NAME OF THE VILLAGE
1	DESA KARANG ENDAH	9	KELURAHAN SAUNG NAGA	17	KELURAHAN BATURAJA LAMA
2	DESA TANJUNG KARANG	10	KELURAHAN TANJUNG AGUNG	18	KELURAHAN SUKARAYA
3	DESA KARANG AGUNG	11	KELURAHANTALANG JAWA	19	KELURAHAN KEMALA RAJA
4	KELURAHAN BATU KUNING	12	KELURAHAN AIR GADING	20	DESA AIR PAOH
5	DESA BATU PUTIH	13	KELURAHAN PASAR BARU	21	KELURAHAN BATURAJA PERMAI
6	DESA SUKAMAJU	14	KELURAHAN SUKAJADI	22	KELURAHAN SEKAR JAYA
7	DESA PUSAR	15	DESA TANJUNG KEMALA	23	DESA TANJUNG BARU
8	DESA LAYA	16	DESA TERUSAN	24	KELURAHAN SEPANCAR
				25	KELURAHAN KEMELAK

Figure 1 *Division of the City Zone of Baturaja*

5. Then connect the zone and the nodes on the road network with the connector. Then press Ok.
6. The next step is inputting the origin-destination matrix (Matrix OD) data.
7. After inputting Matrix OD data, the next step is inputting the types of vehicle.
8. Making procedural sequence
9. Editing Demand of standard 4-step modeling
10. At this stage the procedure will be carried out to get a model of the number of generation and attraction. Click the production / attraction button.
11. Calculating Trip Distribution
12. Calculating Trip Assignment
13. The loading of routes is calculated using the equilibrium assignment model.
14. The results of the analysis are displayed in a tabular form.

3 RESULT AND DISCUSSION

3.1 TRAFFIC CONDITIONS OF BATURAJA CITY IN PADA TAHUN 2019

An analysis of Trip Distribution was conducted in this study to determine the number of movement distributions for each zone. In this case, the Origin-Destination Matrix (ODM) with a uniform method was analyzed because it was assumed that the growth of each zone was the same and calculation was also carried out with the help of the Visum Program with the doubly constrained method. Based on the data on the growth rate of vehicles in the city of Baturaja during the interval of the last 20 years obtained from the Baturaja City's Central Bureau of Statistics, it was found that the vehicle growth rate averaged 3.20% per year. And because the sample taken amounting to 5% of the data in the field, to get a 100% sample then all the ODM data were multiplied by 20. So that the Desire Line distribution travel prediction data were obtained. These ODM data were used in making the route

loading model in the Visum Program. After the origin-destination matrix for 2019 and those of other years of analyses were obtained and inputted into the program, the next step of the study was to do a modeling simulation with the Visum Program. Basically the process of traffic loading is the last stage of four-stage transportation planning, which is getting the best route in carrying out movements between zones. The route is the route traveled with the nearest distance with the fastest time or with the cheapest travel costs [3]. The results of travel route loading of the 2019 analysis model using the Visum Program are shown in Figure 2 and the results of the analysis are shown in Table 1.

Table 1. ***Results of Analysis of the Travel Route Loading Using the Visum Program and the results of a Traffic Count survey***

NO	STREET NAME	CAPACITY (C)	SURVEY RESULT (SMP/HOUR)	DEGREE OF SATURATION (V/C)	RESULT OF TRIP ASSIGNMENT ANALYSIS (SMP/HOUR)	DEGREE OF SATURATION (V/C)
1	H.Agus Salim	2508	89	0,035	100	0,040
2	Pahlawan Kemarung	3135	2321	0,740	2520	0,804
3	Kapten Syahrial	3135	677	0,216	420	0,134
4	Jembatan Ogan I	3135	2544	0,812	2360	0,753
5	Jenderal Ahmad Yani	3135	1131	0,361	1400	0,447
6	Dr. M. Hatta	3135	1467	0,468	960	0,306
7	Gatot Subroto	3203	2666	0,832	3140	0,980
8	Kolonel Burlian	2921	1211	0,415	1220	0,418
9	Raden Fatah	2182	755	0,346	820	0,376
10	H Moh Husni Thamrin	2182	653	0,299	520	0,238
11	Imam Bonjol	3135	972	0,310	1040	0,332
12	Prof Dr Hamka	3134,9	611	0,195	640	0,204

Source: *Results of Analysis of Visum Program, 2019*

Based on the data presented in Table 1, the results of the analysis using the Visum Program can be concluded that the traffic condition in the City of Baturaja still has a degree of saturation ratio (v/c) which approaches the value of 1 on several road segments. The road segments are Jalan Pahlawan Kemarung, Jalan Jembatan Ogan I and Jalan Gatot Subroto. The overall traffic condition is still safe because the road sections are still able to accommodate the volume of loading of the traffic.

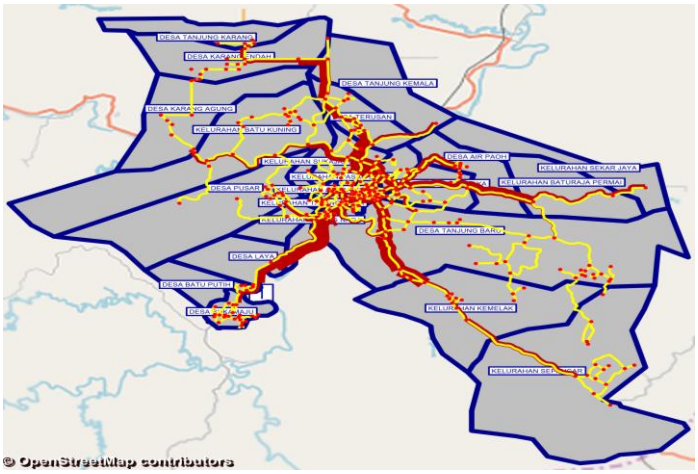


Figure 2 *Trip Assignment Model with the Visum Program*

3.2 Reliability Of The Model

The analysis of the reliability of the model is done to compare the results of the analysis of the route loading calculated with the Visum Program with the results of the flow survey in the field (Traffic Count) as presented in Table 1. The reliability of the model is done by testing the reliability of the model to find out the determinant coefficient (R^2) [3]. If the result of the R^2 is close to 1, it means that the modeling results are said to be very good and can represent the existing condition in the field. The results of the reliability test are shown in Figure 3.

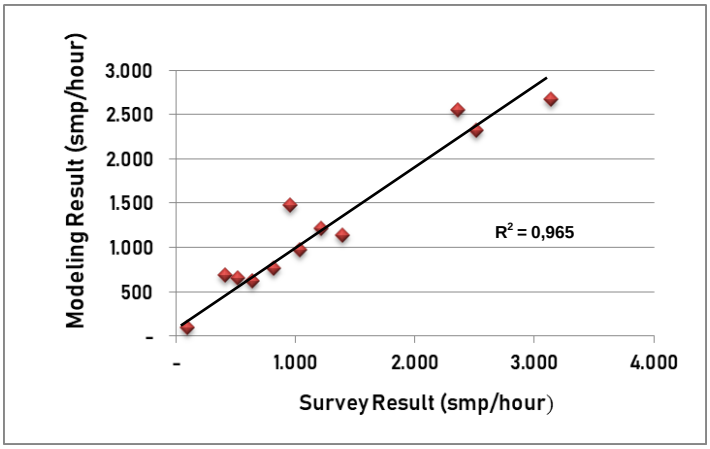


Figure 3 *Results of regression analysis and coefficient of determination (R^2)*

The results of the analysis of the travel route loading and the results of the Traffic Count survey in the field can be seen in Table 1. After the reliability test of the model is conducted, the determinant coefficient (R2) of 0.965 is obtained as shown in Figure 3 above. This result states that the results of the volume of traffic loading that has been modeled using the Visum Program resemble the volume of the traffic loading of existing traffic condition in the field. This means that the model developed can analyze the loading of traffic volumes on the road segments to be studied well, so that road segments that experience saturation and alternative routes can be found to be used to transfer the excess flows. The results of this study can also be beneficial for the government that will carry out the development and improvement of road or bridge infrastructure in the future.

3.3 Analysis Of Trip Assignment On Existing Bridges And New Bridges

This analysis was conducted to analyze the traffic problems in the City of Baturaja. There are 5 existing bridges that were built to connect several villages in the City of Baturaja. In 2019 the local regency government will build 2 bridges located within the Baturaja City area. The bridge is the Ogan V bridge and the Axis Bridge of Tanjung Baru Village. To find out whether these two additional bridges to be built can help spread the movement of excessive traffic in the City of Baturaja, an analysis of the loading of traffic on existing bridges is necessary. Loading analysis is done using the Visum Program. The results of the analysis can be seen in Table 2 as shown below.

Table 2. ***Results of Analysis of Traffic Flow Loading on Existing Bridges***

No	Names of Bridge	Street Capacity (C)	Existing		After the construction of bridge 1		After the construction of bridge 1 and bridge 2 (Ogan V dan Poros Tanjung Baru)	
			Volume (smp/hour)	V/C	Volume (smp/hour)	V/C	Volume (smp/hour)	V/C
1	Ogan 1	3135	2360	0,753	2360	0,753	2280	0,727
2	Ogan 2	5351	4440	0,830	4300	0,804	4300	0,804
3	Ogan 3	3135	0	0,000	0	0,000	400	0,128
4	Ogan 4	3135	700	0,223	700	0,223	0	0,000
5	Gatot Subroto	3203	3140	0,980	3140	0,980	3140	0,980
6	Ogan 5	3203	0	0,000	140	0,044	140	0,044
7	Poros Tanjung Baru	3203	0	0,000	0	0,000	700	0,219

Source: *Results of Analysis of Visum Program, 2019*

Based on the data on Table 2, it can be concluded that after the two bridges were built, there was a change in the traffic flow on the existing bridge except the Gatot Subroto Bridge which did not change due to the location of the bridge which is on the outskirts of the city. The bridges that experience changes in the traffic flow are Ogan Bridge 1, Ogan Bridge 2, Ogan Bridge 3, and Ogan Bridge 4. Ogan Bridge 1 and Ogan Bridge 2 experienced a reduction in traffic volume. Ogan Bridge 1 experienced decreasing degree of saturation (Degree of Saturation abbreviated as DS) in which in the existing condition the DS value is 0.753 and at the time after the construction of the 2 bridges, the value of the DS decreases to 0.727. Likewise on the Ogan 4 bridge the initial DS value is 0.830 and the final DS value is 0.804. Whereas Ogan 3 and Ogan 4 bridges experienced a transfer of traffic flow. At the time before the two bridges were built, the DS value on Ogan Bridge 3 is 0 or none at all. However, after the construction of the two bridges, the traffic flow became 0.128 (400 smp / hour). And Ogan Bridge 4 also experiences traffic flow transfer. Before the two bridges were built, the DS value on this bridge was 0.223 (700 pcu / hour). However, after the two bridges are built the traffic flow on the bridge becomes 0, which means that it moves to another road whose route is shorter and the travel time is faster. The conclusion of the analysis of route loading with the Visum Program is that with this macrosimulation program we can know better the loading of traffic in a region as a reference for the development of transportation infrastructure in the future. In addition, we also obtain alternative route choices which are relatively closer with shorter time of travel.

4 CONCLUSION

a. The loading of travel routes in Baturaja City modeled with the Visum program and the existing conditions in the field that have been tested for its model reliability with reliability testing has very good results with a determinant coefficient (R2) of 0.965, which means that the modeling can present current road network traffic condition in the field. So that we can easily analyze the loading of the future traffic flow.
b. After the loading analysis with Visum Program on several road segments and on the existing 5 bridges, the result was obtained that the value of degree of saturation was no more than 1 for each road segment and bridge both in the existing condition and after additional bridges were built which means that the road segments and bridges are still able to accommodate the existing traffic load.
c. In addition, with the construction of the 2 additional bridges, there is a change in the traffic flow of the 4 existing bridges except on the Gatot Subroto Bridge. The bridges undergoing changes in the traffic flow are Ogan Bridge 1, Ogan Bridge 2, Ogan Bridge 3, and Ogan Bridge 4. This means the construction of these additional bridges helped spread the volume of traffic on the existing bridges to the new bridges to help reduce the traffic burden and this greatly affects the traffic condition in the City of Baturaja.

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