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Pattern of Traffic Movement Changes due to Land use Alteration

Aldes Sam Bera[1], Amsori Muhammad Das[2]
[1] Department of Civil Engineering, Universitas Bina Darma, Sumatera Selatan 30264, Indonesia;
aldes.sambera@binadarma.ac.id
[2] Department of Civil Engineering, Universitas Batanghari, Jambi 36122, Indonesia;
amsori.m.das@unbari.ac.id

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Abstract:
Any development and operation alteration of an area that will directly or indirectly affects the operation of road traffic should be screened for traffic impacts. Traffic congestion is one of the major problems faced by road users that has access to Parameswara road in Palembang. The phenomenon of road alteration along the Parameswara road needs to be identified to analyse overall road performance and to predict the actual picture or simulation model of effects. The dynamics of land use and performance of road movement patterns are predicted as potential factors of congestion. Therefore, the purpose of this study are to analyze the delay and length of vehicle queues due to land use activities on Parameswara road as well as to recommend efficient strategy in reducing the delay time and vehicle queue length, thus, increasinge the road performance. Hence, this research incorporates Vissim 8.00 microsimulation program to simulate existing or current conditions, and predicts road conditions for the next 5 (five) years and 3 (three) by endorsing alternative solutions for traffic congestion.

Keywords: *Land Use, Level of Service, Delay, Queue Length.*

I. INTRODUCTION

The development of a city depends on population factors (replace with 'dynamics'), human life activities, and complex activities growth in urban areas and the necessity for transportation facilities. Moreover, the growing (progressing) economic activities in the urban areas amplifies passenger and freight movement [1], [2]. Though increasing urban freight movement catalyses economic prosperity of these cities, but it is also responsible for increasing emissions and road congestion. Urban agglomerations, involves interactions between the built environment and the location of these economic activity generators and causes additional freight trips to met the service requirements of these centers. Several researchers have analyzed the relation of urban form to travel behavior of passenger with several indicators of the built environment [3]–[6], as well as analysed the literature on urban form variables which includes urban freight studies and its impact on freight trip generation.

Quantity of urban freight trips are decided based on the logistics as well as demands-and-supply of economics [7]. The logistical decisions are based on road characteristics, trip length, environmental policy and the land use. Thus, Freight Trip Generation (FTG) depends on the intrinsic city characteristics, while Freight Generation (FG) depends on the economic activity and the economic character of the city. The presence of a certain economic activities such as retail, wholesale, warehouse or other services contributes to the freight trip generation in an urban area [8]. [9] The development of mode of transportation, the large number of vehicles, transportation facilities and infrastructure are needed to support the needs of the community and to promote growth of the regional development. Hence, transportation planning is inseparable in urban and regional planning. Every development and operation of an area that will and has an impact on the operation

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of a road traffic should be screened using Traffic Impact Analysis (ANDALALIN), to assess the traffic effects of an area development on the transportation network [10], [11] The analysis also helps to study the interior traffic circulation of the developed area that. Analysis of traffic impacts due to land use changes (Land use) on the Parameswara Road. Palembang, was conducted in this study under the Law Number 23 of 1997 and incorporating Environmental Management article 18 paragraph 1 and Law Number 22 of 2009 which involves traffic and road transportation.

ANDALALIN analysis was used to determine changes in land use trends of Parameswara Road, Palembang as well as to predict the impact caused by the generation and trip attraction in the region. In terms of construction, building owners along the Parameswara road are required to prepare UKL / UPL or AMDAL documents with reliable material [11]. The purpose of the study is only limited to the calculation of the Queue Length and Delay of vehicles via Vissim microsimmulation program. Traffic flow and type of vehicles that exists at the location of the activity were recorded without examining deeper into the factors of land use, social, and economic.

The objectives of this study include:

1. To analyze the impact of congestion caused by land use activities on Parameswara Road.
2. To Provide solutions needed to accommodate changes that occur due to land use activities on Parameswara Road.

II. LITERATUR REVIEW

The association between urban system and transportation request were studied comprehensively by many researchers. Research output reported the implication of land utilization and surrounding of constructions on travelling trip of genereation and its' mobility and purpose, as well as choice of travelling form, location, geographical scope and number of trips [12]–[15]. The researches concluded construction surroundings influences travelling activities. Studies by [16]–[18] relates choice of transportation form and construction surroundings. Cervero notified that construction surroundings as one of the defining factors for choice of mode and noted that the variables are not reasonable because of incorrect characters of model, inadequate data, etc [19]. Many recent studies summarized that construction surroundings do influences demand for the commuter services. Hence, concludes that the expansion of construction surroundings of a city branded by the socioeconomic situation of local population and their travelling choices.

Whilst on the freight scopes, many researchers tries to correlate spatial distributions of freight and alteration in logistics on development patterns by considering location of logistics facilities [20]–[22]. The form of built features and spatial design of freight frequency for trade distribution in city, through spatial relapse, had concluded the population concentration influences the utilization of merchandizes in household. [23] He studied the influences of city form on freight, as well as correlation amongst city shape, facility site, land utilization and road freight through statistic [23], incorporating parameters of trip behavior. Number and duration of a trip of a consignment influenced by spatial dynamics such as facility site, demography, socioeconomic and freight accessibility. The national development of freight arrangement often overlook these factors [24], [25] assesed construction surroundings, freight service phases and operations by correlating them to commercial similarity, hotspot as well as global and resident spatial relationship.

Land utilization factors such as stratification of end trip frequently used in literatures [26] to explain models of generation trip. Moreover, [27] also incorporates land utilization and its features such as land tenure, locality development, movements, structure and function of building when discussing attraction model. They concluded that majority of the

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models harvested into continuous fixed trip per each set at a 18% significant rate of employment. Due to more similar groupings of FTA attraction, land utilization models are better than ITE trip models. Some of the studies reveals that land utilization and economic factors intensifies model recognition for freight trip and generation [7], [28].

Many research on generation trips assessed the impact of construction surroundings on movement activities but, [23], [8], [29], introduces the implication of land utilization fusion and generation trip, as well as proved truck length declines inversely with addition of facilities, accessibility to infrastructure, mode of choice and road connections [29]. In addition, he also uses land utilization as a proxy model of area and assessment costs to predict Freight Trip Generation. The model incorporates geographic location, land utilization in destination area, land value with economic factors such as network linkages, employment and frequency of good delivery to a location. The study reveals that non-linear characters, location and spatial factors increases the accuracy of FTA models [8].

Traffic impact analysis or Andalalin is a mechanism to assess the effects caused by traffic due to regional development of the surrounding transportation network [10]. Basically, the traffic impact analyze implication of land modification on the system of movement of the surrounding traffic flow because of new traffic generation, switching traffics, and mobility of the vehicle [30].

According to [31] Trip Generation (TG) can be interpreted as the large number of trips, movements, or traffic generated by a zone (region) perunit time (persecond, minute, hour, day, week and so on). From this understanding, the trip generation is a transportation modeling stage that estimates and predicts the number (number) of trip originating (leaving) from a land area, (the number) or is attracted (to) towards a future area (planned years) perunit time [31].

Qualitative measure namely, Level of Service (LOS) explains the operational conditions in a traffic flow and it's' driver and passengers impression. Each facility can be evaluated based on six service levels, from A to F, where A, represents the best operational conditions whereas F, denotes the worst conditions [32]

Land use relationship, movement patterns, road service levels, and spatial planning are closely related to transportation policy [32]. When transportation access of an activity area is improved, the activity space becomes more attractive, and progressive [33]. This transportation development causes overload issues, which must be addressed. Theis cycle will repeat if accessibility is improved, for example, shorter travelling time increases rate of convenience [34]. The level of service of the LOS road measures quality (taking into account the comfort and geometric factors of the road), and traffic volume limit of a road [30].

The analysis parameters are determined based on ;

a. Model calibration parameters that is limited to queue, delay, traffic volume, speed, and travelling duration,
b. The performance parameters of the road are limited only by: Qqueue length and vehicle delays.

III. METODOLOGI

Initially, literature studies were conducted to facilitate the research implementation and result analysis. Field studies were carried out to determine the exact conditions of the field. The survey location, point of observation and peak hour were determined in the research location. The location of study was Parameswara road section with specific observations in two different intersections, namely: Simpang Macan Lindung (SML) and Simpang Demang Lebar Daun (SDLD). The survey was carried out for 12 hours on, Monday, June 3rd 2019 at a busy hour i.e. morning, afternoon and evening. The survey activity

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was carried out by surveyors who have agreed to participate as predetermined schedule. The component of the survey includes volume count, traffic light, road geometric and spot speed. Apart from survey forms, and spot speed tools, stopwatches and meter measuring tools were used to measure vehicle speed, signal of passing time, and road geometries respectively.

Fig 1. The research location of the Parameswara road

Microsimmulation Program Vissim 8.00 was used to analyze and identify problems in the field. Traffic handling is the best, optimal and effective measure to overcome problem in the study location which also give out chances for higher utilization with smallest risk..

IV. RESULT AND DISCUSSION

Traffic survey activities were carried out during 12 hour of rush hour, starts from 06.00 WIB until 18.00 WIB at locations with recap time intervals every 15 minutes. The obtained traffic traffic was multiplied by emp. The analysis of this study uses traffic flow of one busiest hour (peak hour) with units of junior high school or hours at each approach from the study site towards existing, or current condition, with considering predicted conditions and in 5 years. The formula of condition prediction for 5 years with i at 2.5% is as follows:

$$LHRT = LHRo.\ (1+i)^n$$

Then the LHR for 5 years becomes:

$$LHR5 = 84,3.\ (1+0,025)^5$$
$$= 95,38 \text{ pcu/sec}$$

Table 1. Existing peak hour records in Parameswara Road.

Road	Direction	Time	Pcu/hour
Parameswara	SML	Morning	1135.3
		Noon	1119.1
		Afternoon	1316
	SDLD	Morning	1091
		Noon	968
		Afternoon	1126.7

Table 2. Peak hour prediction for the next five years in Parameswara Road

Road	Direction	Time	Pcu/hour
Parameswara	SML	Morning	1284,49
		Noon	1266,2
		Afternoon	1468,58
	SDLD	Morning	1234,59
		Noon	1112,17
		Afternoon	1274,76

Table 3. Maximum number of vehicle turn out on the Parameswara road during peak hours

Name	Volume (pcu/sec)
Macan Belang Lane	202,20
Macan Putih Lane	257,40
Macan Lane	194,80
Macan Kumbang Lane	252,50
Pipa Lane	208,50
Merdeka Road	310,22
Macan Lane	188,67
Macan Tutul Lane	104,67
Bambu Kuning Lane	100,00

In this research, the vehicle speed survey activity refers to the speed of the vehicle during free flow or the sliding speed of the vehicle measured. This observation was carried out at night by taking a sample of 30 for each type of vehicle perapproach.

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This vehicle speed parameter data is used as an input for VISSIM 8.0. Data obtained from the local speed survey or spot speed (SS) are as follows:

Table 4. Spot Speed on Parameswara Road

Road	Direction	Trans type	Min (km/ hour)	Max (km/ hour)
Parameswara	SML	Motor cycle	20,02	37,03
		Light vehicle	18,01	67,05
		Weight vehicle	20,02	20,02
	SDLD	Motor cycle	23,02	70,06
		Light vehicle	18,01	60,05
		Weight vehicle	20,02	37,03

In this study, an analysis of traffic simulations was carried out in two present and future conditions and future alternative solutions were suggested to improve the system of traffic performance of Parameswara road. Firstly, is evaluating the current road condition, followed by traffic conditions prediction along the parameswara road. Then, alternative form of solutions to improve the traffic performance system on this road. The performance analysis of this road section was carried out using VISSIM 8.00 microsimulation program. The following are the conditions performed for this study.

4.1 Existing Conditions of Parameswara Road

The traffic analysis and simulation, shows that average vehicle delay and maximum queue length (Qlenmax) during rush hour conditions are affected by changes in land use. Their results of the morning, afternoon and evening rush hours can be seen in table 5 :

Table 5. Results of vehicle delay and Qlenmax times of busy hour existing conditions on each direction.

Direction	Average delay (sec/ pcu)	Queue length (meters)
SML	66,68	117,26
SDLD	45,45	102,71

Fig. 2. Existing Condition Simulation on Parameswara Road

4.2 Prediction of Parameswara Road conditions for the Next five years

Analysis and simulation shows that traffic shows that average vehicle delay and maximum queue length (Qlenmax) during rush hour conditions will be busy in the next five years. Results of Microsimulation Vissim 8.00 are in Table 6 :

Table 6. Results of vehicle delay duration prediction conditions for the next 5 years in each direction on busy hours.

Direction	Average delay (sec/ pcu)	Queue length (meters)
SML	86,89	144,42
SDLD	65,77	121,31

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Fig. 3. Simulation of prediction conditions for the next five Years

4.3 Alternative solutions used in Parameswara Road

4.3.1 Alternative Solution 1

Parking arrangements seems to be one of the desirable solutions after proper traffic analysis and simulation. vehicle delay average and maximum queue length (Qlenmax).

Table 7. Alternative Results 1

Direction	Average delay (sec/ pcu)	Queue length (meters)
SML	77,63	93,62
SDLD	55,62	81,67

Fig. 4. Alternative Simulation 1

4.3.2 Alternative Solution 2

Apart from parking arrangements, geometric widening is one of the mechanisms that could help in traffic issue. From the results of traffic analysis and simulation, the output obtained in the form of vehicle delay average and maximum queue length (Qlenmax) in alternative solution 2, namely:

Table 8. Alternative Results 2

Direction	Average delay (sec/ pcu)	Queue length (meters)
SML	58,81	75,21
SDLD	31,44	56,65

Fig. 5. Alternative Simulation 2

4.3.3 Alternative Solution 3

Incorporating efficient parking arrangement on widened geometric area is expected to help the local authority to handle the issue in a sustainable manner. From the results of traffic analysis and simulation using the VISSIM 8.00 microsimulation program, the output obtained is vehicle delay average and maximum queue length (Qlenmax) in alternative solution 3, namely:.

Table 9. Alternative Results 3

Direction	Average delay (sec/ pcu)	Queue length (meters)
SML	33,95	51,19
SDLD	20,43	36,22

Fig. 6. Alternative Simulation 3

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Traffic impact analysis was carried out on previous and present condition using Vissim 8.00. Parking arrangements and, or geometric widening strategies were used on shops or offices along Parameswara Road with an land use changes activities. The results are close to the field conditions because VISSIM 8.00 also analyses speed, geometric, and several other variable factors, such as parked vehicle condition of a land use activities to narrow down ground condition. All this condition can be simulated visually so as to facilitate understanding of the problem. The following is a summary of vehicle delay average and maximum queue length (Qlenmax):

Table 10. Summary of average vehicle delays and provided alternatives

Direction	Existing (sec/ pcu)	Prediction 5 yr (sec/ pcu)	Alt-1 (sec/ pcu)	Alt-2 (sec/ pcu)	Alt-3 (sec/ pcu)
SML	66,68	86,89	77,63	58,81	33,95
SDLD	45,45	65,77	55,62	31,44	20,43

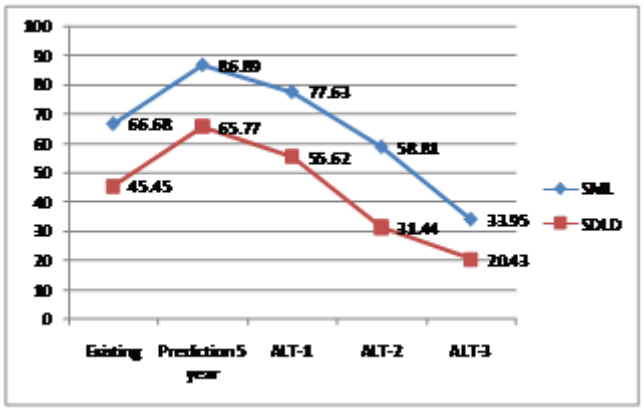

Fig 7. Comparison chart of average vehicle delays

Table 11. Recapitulation of Qlenmax and suggested alternatives

Direction	Existing (sec/ pcu)	Prediction 5 yr (sec/ pcu)	Alt-1 (sec/ pcu)	Alt-2 (sec/ pcu)	Alt-3 (sec/ pcu)
SML	117,26	144,42	93,62	75,21	51,19
SDLD	102,71	121,31	81,67	56,65	36,22

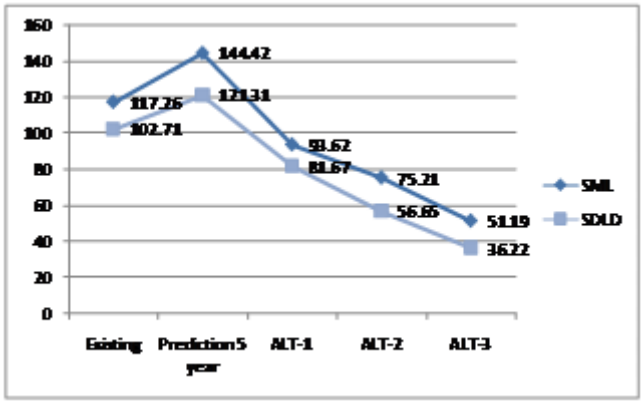

Fig 8. Qlenmax Comparison Chart

V. CONCLUSION

This study proves that changes in land use on the Parameswara road increases average vehicle delay time (direction delay approaching the protected tiger intersection by 66.68 pcu / hour, the approaching direction of the wide intersection leaves at 45.45 pcu / hour and maximum queuing length (Qlenmax) on the Parameswara road approaching the protected the tiger intersection at 117.26 pcu / hour, the approaching direction of the leaf width intersection crossing 102.71 pcu / hour).

Integrating parking arrangement and geometric widening is the best measure to handle traffic problems due to land use changes in Parameswara Road. It is because, the average delay time of approaching vehicle at the protection lever is 33.95 pcu / hour, the approach direction of leaf width intersection is 20.43 pcu / hour and the maximum queue length (Qlenmax) on the Parameswara road approachesing protection lever intersection at 51.19

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pcu / hour, whilst direction of approach of leaf width intersection is 36.22 pcu / hour.

Analysis concluded that existing changes in land use on the Parameswara road implicated in problematic traffic conditions in residential areas and parking problems in shops / and offices. Exiting vehicles, especially cars create obstacles for passing vehicles. This has not yet considered the problems created by carelessly parked vehicles on the roadside of PGRI 1 Vocational High School.

Therefore, it is necessary to verify the existanceing of any buildings on Parameswara street, especially shop houses. The bulding should have a valid legal building permit (IMB) and constructed in accordance with the land use requirements of local authority to avoid road area consumption. Excess used land should be returned to the local authority if any shops or offices does not follows the requirements. so that widening can be done on the Parameswara road. As an alternative measure, better parking arrangements and road geometric widening can be executed to reduce the delay time and queue length compared to other conditions.

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