EVALUATION OF IMPACT OF BOTTLENECK CAUSED BY ON-STREET PARKING IN DOWNTOWN OF VIENTIANE, LAOS.

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1. INTRODUCTION

Due to the rapid growth of motorization, traffic condition in Vientiane, the capital city of Laos is facing deterioration experience. But off-street parking space and parking facilities have not been provided sufficiently. Consequences, illegal on-street parking had been happened and creates bottleneck which lead to traffic congestion. In 2013, the Vientiane Sustainable Urban Transport Project was approved in order to improve traffic problem. However, the impact of introduction of on-street parking management has never been evaluated and analyzed. This study aims to evaluate an impact of bottleneck caused by on-street parking based on flow rate, average speed and travel time.

2. LITERATURE REVIEW

Shikata [1] study the effect of on-street parking on signalized intersection capacity. Saturation flow rate was observed and used for estimation of intersection capacity. The data show a decrease in saturation flow rate by parking vehicles. It is proved that this result is caused decreasing the rate of approach volume. **Yousiff and Purnawan** [2] considered the type of parking manoeuver both of parallel and angle parking by which angle parking manoeuver was major created congestion. **Hongwei Guo** [3] proposed a Hazard-Based Duration Model to analyze the influential factors related to on-street parking, including lane width, the number of maneuvers and occupancy. Study revealed that on-street parking has a significant impact on the travel time of vehicles. **Sugiarto and Thirayoot** [4] used oblique cumulative plots and breakdown method to examine the impact of on-street parking on deterioration both travel speed and capacity. It found that capacity diminished compared to the pre-breakdown condition. Also, traffic microsimulation software (VISSIM 5.30 version) was dominated to estimate the measurement of effectiveness by removing on-street parking from a site of study.

3. METHODOLOGY

This paper develops traffic microsimulation model (VISSIM 5.40) to evaluate the impact of on-street parking vehicle in center business district area of Vientiane known as Chanthabouli district. Study area composes of four major roads such as Lane Xang Avenue, Samesenethai road, Setthathirath road and Khunboulom road. The following process was applied to this study:

- Preliminary survey regarding identify parking behavior;
- Select critical road section to conduct social experiment to observe the influence of on-street parking.
- Develop traffic microsimulation model in order to confirm reliable and validate on-street parking management.
- Simulate the impact of on-street parking control in different scenarios throughout road network.

4. DATA COLLECTION

Preliminary survey on parking behavior was conducted to identify characteristic of on-street parking in August 2015. Then, floating car survey and video recording were conducted to observe travel speed, travel time and traffic volume on 1/September/2016 on which on-street parking was prohibited by local polist as the social experiemnt and also on 13/September/2016 as the ordinally condition.

5. DATA ANALYSIS AND RESULTS

5.1 Parking Characteristic

As the result of preliminary survey, majority who park on streets was private employee. Subsequencely, follows by public officer, student, bussiness, worker and wifehouse. It was also found that most of vehicles were parked over 8 hours at same place during weekday, show in figure 1.

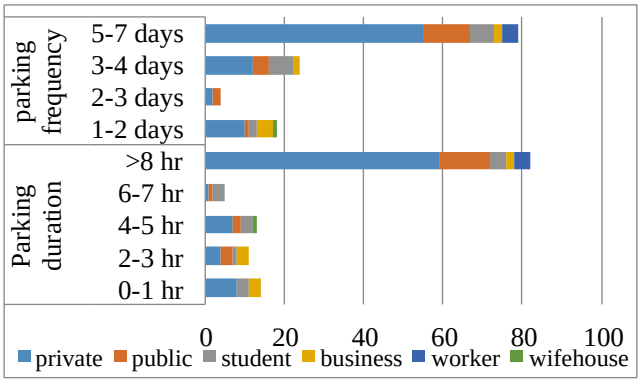

Figure 1. Duration and frequency of Parking

5.2 Traffic Volume

Peak hour volume which were shown in figure 2 were input to a traffic microsimulation model in order to evaluate the impact of proposed parking policy.

Keywords: On-street parking, Evaluation, Bottleneck, VISSIM, Vientiane.
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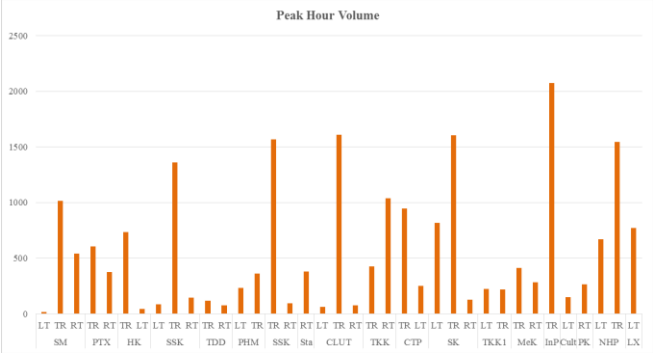

Figure 2. Hourly volume on observed intersections

5.3 Speed and Travel Time

As the result obtained from simulation, two scenarios (existing condition and remove illegal on-street parking) were examed. It was found that the speed was increased by 44% for critical section and 27% for whole area. Mean while travel time was gradually decreased by 34% for critical section and 28% for whole area. Details were illustrated in table 1 and 2.

Table 1. MOE parameters of critical section

Senarios	Speed (km/h)	Travel Time (sec)
1. Existing condition	9	64
2. Remove parking	12 (44%)	42 (-34%)

Table 2. MOE parameters of whole area

Senarios	Speed (km/h)	Travel Time (sec)
1. Existing condition	15	1001
2. Remove parking	19 (27%)	718 (-28%)

6. MODEL CALIBRATION AND VALIDATION

In order to confirm the best result between simulation model estimation and field measurement. Generally, parameters such as volume and speed will be compared with the results of field data. In this study, volume, speed and travel time were used to verify reliability of developed model as well as validation of the model that had effected to traffic behavoir of driving and accurate results in the study area. Table 3, 4 and 5 shows the result of calibrated model. On the other hand, the GEH statistic is a criteria for model calibration. The GEH statistic is computed as follows:

$$GEH=\sqrt{\frac{2(E-V)^2}{(E+V)}} < 5 \text{ (single link)} \qquad (1)$$

Where:

E: model estimated volume
V: field count volume

Moreover, speed is accepted within 20%, mean while travel time is accepted within 15%.

Table 3. Travel time of model versus observed

Scenarios	Travel Time (sec)		% Diff.	Logical Test
	Model	Observed		
Existing	1,001	947	5.70	Accepted
Remove	718	678	5.90	Accepted

Table 4. Speed of model versus observed

Scenarios	Speed (km/h)		% Diff.	Logical Test
	Model	Observed		
Existing	15	14.25	5	Accepted
Remove	19	17.70	6.84	Accepted

Table 5. Flow rate of model versus observed

Collect Point	Flow rate (vph)		% Diff.	Logical Test	GEH	Logical Test
	Model	Observed				
1	1160	1156	0.36	Accepted	0.12	Accepted
4	474	462	2.65	Accepted	0.56	Accepted
5	1282	1362	-5.91	Accepted	2.21	Accepted
7	246	241	2.03	Accepted	0.31	Accepted
8	352	350	0.44	Accepted	0.08	Accepted
9	469	487	-3.76	Accepted	0.84	Accepted
18	1212	1227	-1.24	Accepted	0.44	Accepted
10	2813	2762	1.83	Accepted	0.96	Accepted
13	113	110	2.63	Accepted	0.27	Accepted
14	689	715	-3.64	Accepted	0.98	Accepted
16	303	292	3.73	Accepted	0.63	Accepted
17	205	200	2.67	Accepted	0.37	Accepted
19	218	220	-1.01	Accepted	0.15	Accepted
20	260	254	2.27	Accepted	0.36	Accepted
Total	9794	9838	-0.45	Accepted	0.44	Accepted

7. CONCLUSION

To sum up, in this study an impact of bottleneck caused by on-street parking was evaluated. Two scenarios were tested in case of removing illegal parking and do nothing in order to clarify effective parameter to traffic performance deterioration during peak hour. Simulation model was employed to estimate the impact of bottleneck caused by on-street parking vehicles through out study area. It found that, speed was slightly increased by 27%, and travel time decreased by 28% after removed parking vehicles. Despite, GEH statistic was used to verify and validate created model. It assumed that on-street produced a significant impact on deterioration of traffic performance. It is recommended that removing illegal parking is necessary for improving the quality of sevice.

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