Estimation of Impact of Improvement of Traffic Signal Control on Traffic Congestion Reduction in Bangkok

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Watana NGOENCHUKLIN[1], Atsushi FUKUDA[2], Hideyuki ITO[3]

[1]Graduate School of Science and Technology
Nihon University
Telephone +81-47-469-5355, Fax +81-47-469-5355
E-mail: cswa11007@g.nihon-u.ac.jp
guitarizer@hotmail.com

[2]College of Science and Technology
Nihon University
Telephone +81-47-469-5355, Fax +81-47-469-5355
E-mail: fukuda.atsushi@nihon-u.ac.jp

[3]College of Science and Technology
Nihon University
Telephone +81-47-469-5355, Fax +81-47-469-5355
E-mail: ito.hideyuki@nihon-u.ac.jp

Abstract

In Thailand, many intersections have suffered from traffic congestion because of an inefficient traffic management. At worst, some cars can be stuck at one intersection for hours. Eventhough some traffic signals in Bangkok are already changed to adaptive signals, there are still many places that uses the old fixed-time signals with 4 green phases system. In addition, comparing with foreign countries, it was inefficient signal control system because it has a lot of delay and made more queue to other than green direction. Moreover, in rush hours, many policemen still control the signals to make the traffic smoother. They often make some mistakes by using too long or short green time, as a result, the delay and queuing traffic in those areas is caused. This research aims to find methods that have an optimized cycle length and to adapt signal phases control introduced in other countries' (i.e. Japan or England) to Bangkok. These may help decreasing the delay, queue length and travel time by reducing the signal phases at each intersection. We could analyze the traffic situation and compare the result from many methods by gathering the traffic data around those areas and reproducing the situation by using the micro simulation software (VISSIM).

Keywords: Traffic Signal, Simulation, VISSIM, Phase pattern, Traffic jam, Bangkok, Signal control systems

1. Introduction

1.1. General

there are lots of traffic ,In Bangkok which are caused by the traffic demand ,problems Japan)ICAJ ,1990Since .and traffic control system in cooperation (International Cooperation Agency (Bangkok Metropolitan Administration)with BMA In .has started the plan to solve traffic problems Split Cycle Offset Optimization)SCOOT ,1994 ,However .system has been installed (Technique rejected by was the system ,any factorsdue to m police officers and changed to controlling signals .by themselves

After the control of in rush hours changes and use ,back to a manual control by police officers count down)down -the fixed time with count peak -in off (system uses only in some intersections many intersections in Bangkok use one ,hours This caused more .one direction phase of green for .traffic congestion in Bangkok

ransportation t various ,Even though still be the sutomobilea ,s has been developededom common transportation method for people in the suitable signal control ,Therefore .Bangkok reduce the traffic to n important rolesystems have a .congestion in Bangkok

1.2. Objectives

Objectives of this research are;

1. to reduce traffic congestion at intersection in Bangkok,
2. to improve traffic signal control in Bangkok.

Traffic signal in Bangkok .1.3

JICA team has been surveyed traffic control in Bangkok since 1990. Although traffic flow problems are occurred in many areas, the traffic parameters of the control system are not updated completely, and only renewed a few times. JICA team also pointed out that the controlling signals by policemen caused many mistakes.

The phase pattern of intersection in Bangkok is used one Direction per one phase, as shown in Fig. 1.

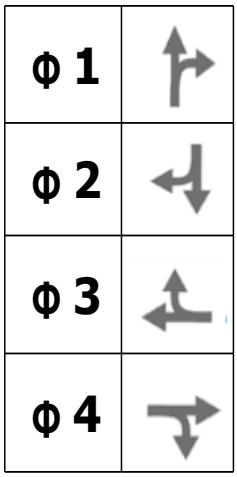

Fig. 1 Phase pattern in Bangkok

2. Literature Review

Several researchers have studied how to solve the traffic problems at intersections in Thailand.

Though the detectors were usually used in modern signal control, the real-time signal with the detectors was developed. The detector was proved to be helping in handling the traffic output from intersection to increase by 45% (Chayanon et al.). Also with the new traffic systems, which installed in Phuket in 2004 by Sumitomo Electric Industries, also used many types of detectors. The new system is a real-time system that adapted from the Japanese system. The effectiveness of its system is proven by many drivers, who said they prefer the system than police officers controlling (Sakakibara et al, 2005). Regarding the research on real-time traffic signal, it depends on the situation and factors that the effect of the system that will be positive or negative. (From SCOOT system plan) (Sarawut et al. 2005). Thus, the real-time traffic control method should adapted to improve service abilities (Grittigrai 2007).

In terms of the spillover at intersections as the point, the analysis of signal split design method aims to minimize the spillover that has been developed but still cannot be used with computers (Polthep 2010). The detectors can be used to response this method by keeping the release volume not to exceed the capacity or next intersection (Chayanon et al.).

The countdown system using in Bangkok can reduce the start-up loss time and disobedience of traffic signals. (Pakasit et al.). The concept of countdown system can be used with the hybrid control method (fixed-time control together with real-time up to situation and time).

Through the literature review, it was found that improvements or changes of signal control system can reduce the traffic congestion. But, the system must be adapted to the situation or it can also make the situation worsen. With Bangkok situation that release car by one direction per one phase, the system should be considered along with phase pattern control. Otherwise the situation might be unchanged. Therefore, we should consider the phase pattern control along with signal control improvement.

3. Methodology

In order to achieve the objectives, the study process has been prepared as in Fig. 2

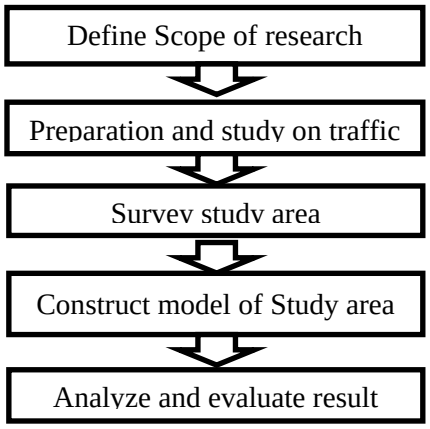

Fig. 2 Methodology flow

The scopes on selected study area are;

1. area should be crowded at peak-hours
2. area must be in Bangkok downtown area
3. intersections in that area should be suffered from the effect of police officers' control.

3.1 Study Area

The selected study area is parts of the inner ring roads of Bangkok. Those are famous roads which always are crowded even in off-peak hours as shown in Fig.3.

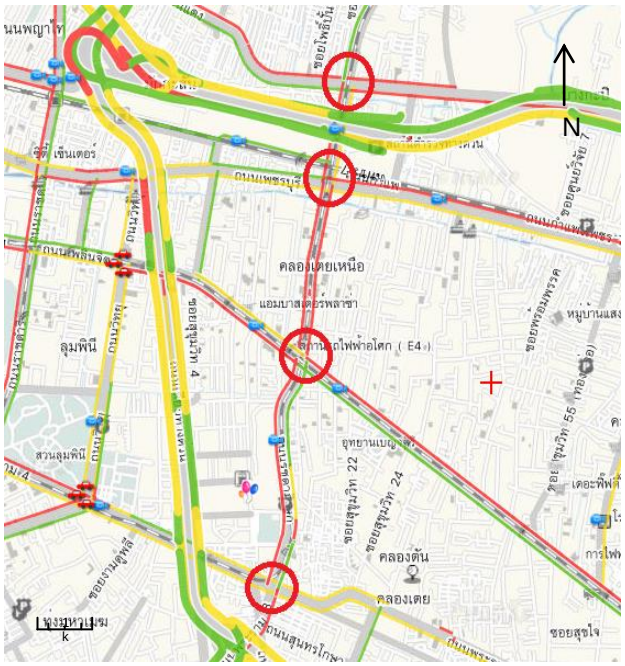

Fig. 3 Study area
(intersections marked with red circles)

4 intersections from south to north included

1. Phraram4 intersection
2. Asok intersection,
3. Petchaburi intersection
4. Phraram 9 intersection

At Asok intersection, it is impossible to expand the road because there is the MRT.(Mass rapid transit) line. In addition, there is BTS (Bangkok Transport System) to east and west. Both of them also have station at Asok.

3.3 Data collection

Data which is needed to use for analyzing in this research are;

1. Incoming traffic volume: by counting and video recording from upstream of every study intersections
2. Intersection traffic volumes: by counting and video recording. Find the average between 10 cycles.
3. Cycle length and split time: by counting and video recording. Find the average between 10 cycles.

Data was collected during various time periods and under various traffic conditions,

1. In peak-hours at morning (7.00-8.00 am.)
2. In peak-hours at evening (6.00-7.00 pm.)
3. off-peak periods (10.00-11.00 am. And 2.00-3.00 pm.)

Data collection was conducted in weekdays, the phase pattern was recorded along with Cycle length.

3.4 Analysis method

In this research, we analyzed by using micro simulation software (VISSIM), which can use specific programming language to program the signals.

The Analysis flow is shown below.

1. Using VISSIM to create simulation of the study area.
2. Program the various signal control methods by using Vehicle Actuated Programming (VAP), which is a programming language to use to control signals in VISSIM.
3. Test various signal control methods in simulation, both one phase one direction and one phase two directions each.
4. Evaluate and compare the result

Results was used for comparison and evaluated;

1. Average delay (vehicle/second)
2. Total travel time (second)
3. Average speed
4. Throughput of intersections
5. Average stop time

4. Test simulation

In 2011, the traffic situation slightly changed in Bangkok, but also suffered from the same problem. We used data from Khonkaen city to conduct test simulation for this research. The survey has been conducted in August 2011.

The study area in this case, we selected the intersection near Central Plaza Khonkaen as our study area. The characteristic is similar to Asok intersection, with department store and special lane for turn-left through the area as shown in Fig. 4.

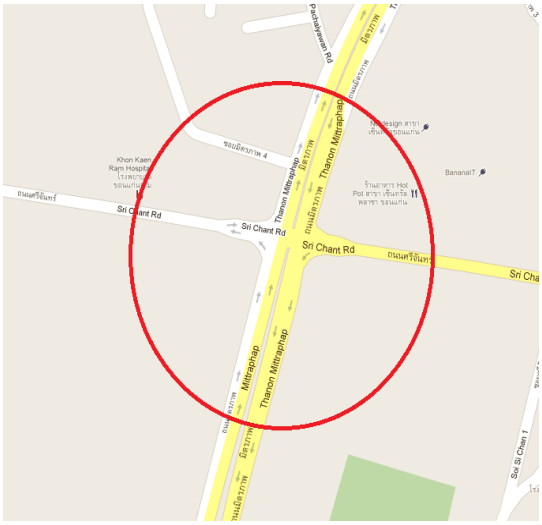

Fig. 4 Study area in Khonkaen

We used the same data collection method, but in this case, as for test we only used one intersection for simulation. The traffic data from survey is shown in Table.1 and cycle and phase pattern as shown in Fig. 5.

Table.1 Central Plaza Khonkaen intersection data in one hour

Traffic data at Central Plaza Khonkaen intersection (veh/hr)					
North to south		2324	East to west		1044
Left	Straight	Right	Left	Straight	Right
676	1404	244	196	320	528
South to north		2174	West to east		748
Left	Straight	Right	Left	Straight	Right
336	1204	634	80	452	216

Phase	Φ1	Φ2	Φ3	Φ4
Direction				
Green	30	30	55	40
Amber	3	3	3	3
Red	4	4	4	4

Fig 5 Cycle and Phase pattern

Total cycle length is 183 seconds By the data above, we have conducted simulation in VISSIM, and changed phase pattern into two directions per phase (Japanese methods) as in Fig. 6 .

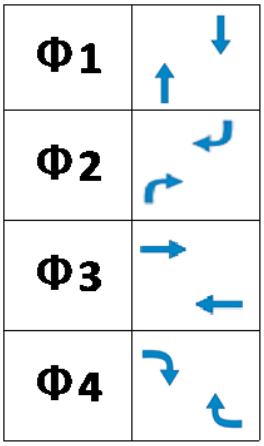

Fig. 6 Japanese phase pattern

5.Results and issues

After conducting simulation with data from test study area, the result was shown in table 4 From table 4, we could see it changed to Japanese phase pattern with optimize fixed time, delays and stop delay decreased

Table 4 Comparing Average delay and Stop Delay

Method	Traditional Thai	Japanese (Fixed time)
Average Delay time (s/veh)	60.18	52.1
Effect(%)	None	13.42
Average Stop Delay (s/veh)	47.41	38.64
Effect(%)	None	18.49

The results comparing average queue length from each methods are shown in Table.5 and 6 respectively.

Table 5 Queue length of Traditional method

Queue Length	U-turn and Right	Straight
Northbound	93.78	85.76
Southbound	95.18	113.9
Eastbound	86.22	86.22
Westbound	96.04	96.04

Table 6 Queue length of Japanese (fixed time)

Queue Length	U-turn and Right	Straight
Northbound	50.52	63.64
Southbound	44.62	104.6
Eastbound	40.78	40.78
Westbound	44.52	44.52

As the results, we could conclude that the traffic flow get better after we changed phase pattern. But, in this test simulation, we only used one intersection as the case study. If we changed the phase pattern and signal control method in corridor or network intersections, it might be a problem to the network.

6. Conclusion

By improve the traffic control with considering about phase pattern, and system, the traffic situation in Bangkok should be able to improve. Moreover, by studying foreign countries systems, it should be able to apply and adapt to make the system to work efficiently.

The main study area's survey will be conducted on August 2012. After collecting data, simulation will be made in September and plan to finish and evaluating results in October-November.

References

[1] นาย พลเทพ เลิศวรวนิช "รายงานฉบับที่ วพ. 283 สำนักวิจัยและพัฒนางานทาง การออกแบบสัญญาณไฟจราจรบนทางหลวง" 2010

[2] ชญานนท์ มินเสน A STUDY OF EFFECTS COUNT-DOWN SIGNAL TYPE SIGNALIZED INTERSECTION

[3] Pakasit Jirasak, A STUDY OF EFFECTS COUNT-DOWNSIGNALTYPE SIGNALIZED INTERSECTION

[4] Hajime SAKAKIBARA, Masanori AOKI and Hiroshi MATSUMOTO. (2005) Advanced Traffic Signal Control System Installed in Phuket City,Kingdom of Thailand.

[5] Sarawut JANSUWAN and Sorawit NARUPITI. (2005) ASSESSMENT OF AREA TRAFFIC CONTROL SYSTEM IN BANGKOK BY THE MICROSCOPIC SIMULATION MODEL *Proceedings of the Eastern Asia Society for Transportation Studies*, Vol.5, pp.1367-1378.

[6] Grittigrai Karalak(2006) REAL-TIME TRAFFIC SIGNAL CONTROL FOR MAXIMIZING NETWORK THROUGHPUT.