Determination of The Level of Service in Two Conditions: With and Without the Police, A Case Study in Tehran

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ABSTRACT

Signalized intersections have a great role in urban transportation and safety. Despite undeniable task of these traffic elements, they are facing many problems such as delays, inappropriate designing, miss using of traffic signs due to locations and dimensions at them. Besides these problems, the existence of traffic police at intersections is not always help to decrease these problems, but also can create more difficulties to the task of signalized intersections which might not obviously visible. For example the traffic police change cycle time and preventing some direction to cross the intersection and let some others cross which may cause more delays and other difficulties for regular and organized movement of vehicles. This study aims to investigate the above problems and find a solution to decrease them. For this purpose, a unique survey designed to analyze the four intersections in Tehran. These intersections selected from one arterial street and the specification of these intersections are somehow the same. The result shows that by changing the behavior of police in these intersections with correct training of traffic rules , can improve the traffic and decrease the delays.

Keywords - signalized intersections, police, traffic, delays.

I INTRODUCTION

Next to being a major cause of stress for drivers, traffic congestion causes travel delays, and thus imposes a substantial cost on society. One way to moderate congestion is to expand the road network, but in an urban area this is often not feasible because of the presence of buildings. On the other hand, traffic management solutions such as introducing and enforcing variable speed limits, installing Local - express lanes or reversible lanes, imposing differentiated road pricing or optimizing traffic signal timing try to improve the performance of the existing infrastructure. Optimization of traffic signal parameters has a long history, starting in the late 1950's with the work by Webster (1958) on the timing of isolated intersections based on statistical methods. Since then, the state-of-the-art has evolved over actuated signals, which lengthen the green period to some extent if a queue is observed, to adaptive and cooperative methods, which are realized using actual flow information supplied by traffic detectors, and which involve series of intersections[3].

Therefore, signal timing optimization is considered to be a multi-objective problem. Prior to development of micro-simulation models, analytical methods were typically employed in studies to plan and improve roadway facilities. These methods can estimate capacity, delay, level of service and other parameters for a given set of roadway conditions. Capacity is a primary concept in most of the traffic engineering studies. Analytical approaches including Highway Capacity Manual (HCM) and the Mcshane attracted many researchers to conduct studies on capacity analysis [2]. This paper endeavors to investigate capacity and queue discharge flow rates at a signalized intersections using a field study of a region in Tehran that the figure 1 of it , is shown on below.

Fig 1 : The region of four intersections

The scope of this study is limited to isolated signalized intersections operations to make it comparable with analytical approaches. More specifically, the objectives of this study are listed as follows:

1. To evaluate the implementation of field study on a signalized intersections and compare its results with traditional analytical approaches and compare with the values of standards.

2. To study and evaluate the field study as an alternative approach for capacity analysis for signalized intersections.

The remaining part of this paper is organized in some sections. In the next section, detailed methodology is presented on framework of this study along with the test description , measures of effectiveness adopted in the analysis. The data used for this study is presented in the traffic count data section. Data analysis is split into calibration process and validation process. Finally capacity analysis is carried out in section 3 and findings of this study are discussed in discussions in end section.

Table 1 : Characteristics of the intersections

Intersection	Volume (veh/h)	Cycle of lights(s)	Control method of intersections
1	4164	118	With & without police
2	4104	155	With & without police
3	3968	154	With & without police
4	3440	146	With & without police

II Methodology

In this paper we use Control Delay studies formula which is about as follows:

Before 1997, the primary delay measure at intersections was stopped delay. While no form of delay is easy to measure in the field, stopped delay was certainly the easy. However, the current measure of effectiveness for signalized and STOP-controlled intersections is total control delay. Control delay is best defined as time-in-queue delay plus time losses due to deceleration from and acceleration to ambient speed. The study methodology recommended in the Highway Capacity Manual is based on direct observation of vehicles-in-queue at frequent intervals and requires a minimum of two observers [1].The following should be noted:

1- The method is intended for under saturated flow conditions, and for cases where the maximum queue is about 20 to 25 vehicles.
2. The method does not directly measure acceleration-deceleration delay but uses an adjustment factor to estimate this component.
3. The method also uses an adjustment to correct for errors that are likely to occur in the sampling process.
4. Observers must make an estimate of free-flow speed before beginning a detailed survey. This is done by driving a vehicle through the intersection during periods when the light is green and there are no queues and/or by measuring approach speeds at a position where they are unaffected by the signal.

Actual measurements start at the beginning of the red phase of the subject lane group. There should be no overflow queue from the previous green phase when measurements start. The following tasks are performed by the two observers:

Observer 1

Keeps track of the end of standing queues for each cycle by observing the last vehicle in each lane that stops due to the signal. This count includes vehicles that arrive on green but stop or approach within one car length of queued vehicles that have not yet started to move. At intervals between 10 s and 20 s, the number of vehicles in queue are recorded on the field sheet.

The regular intervals for these observations should be an integral divisor of the cycle length. Vehicles in queue are those that are included in the queue of stopping vehicles (as defined above) and have not yet exited the intersection. For through vehicles, “exiting the intersection” occurs when the rear wheels cross the STOP line; for turning vehicles, “exiting” occurs when the vehicle clears the opposing vehicular or pedestrian flow to which it must yield and begins to accelerate. At the end of the survey period, vehicle-in-queue counts continue until all vehicles that entered the queue during the survey period have exited the intersection.

Observer 2

During the entire study period, separate counts are maintained of vehicles arriving during the survey period and of vehicles that stop one or more times during the survey period. Stopping vehicles are counted only once, regardless of how many times they stop. For convenience, the survey period is defined as an integer number of cycles, although an arbitrary length of time (e.g., 15 min) could also be used and would be necessary where an actuated signal is involved. Each column of the vehicle-in-queue counts is summed; the column sums are then added to yield the total vehicle-in-queue count for the study period. It is than assumed that the average time-in-queue for a counted vehicle is the time interval between counts and is computed with equation 1 as is used in [1].

Then:

Equation 1:

$$T_Q = \left(I_s * \frac{\sum V_{iq}}{V_T}\right) * 0.9$$

Where:

T_Q : average time in queue, s/veh

I_s : time interval between time − in − queue counts, s

$\sum V_{iq}$: sum of all vehicle − in − queue counts, vehs

V_T : total number of vehicles arriving during the study period, vehs

0.9 : empirical adjustment factor

And
Where:

The final estimate of control delay is then computed with equation 2, 3 as [1] :

$$d = T_Q + (FVS * CF)$$

Where:
d : $total\ control\ dely, s/veh$
CF : $correction\ factor$
$FVS = \frac{V_{stop}}{V_T}$
And V_{stop} : $total\ count\ of\ stoping\ vehicles, vels$

Table 2 : The LOS presented by HCM 2010(2)

Control Delay s/veh	LOS by Volume to Capacity Ratio	
	≤1.0	>1.0
≤10	A	F
>10-20	B	F
>20-35	C	F
>35-55	D	F
>55-80	E	F
>80	F	F

According to the above table, both control delay and LOS of each four intersection presented below:

Table 3: The results of the analyze of intersections

Case	Intersection	Day of The Week	Time	Total control delay (s/veh)	LOS
With the presence of Police	Intersection 1	Saturday	PM	26	C
		Sunday	PM	12.73	B
		Monday	PM	12.13	B
	Intersection 2	Saturday	AM	16.73	B
	Intersection 3	Saturday	AM	13.24	B
		Saturday	PM	15.49	B
		-	PM	-	-
		Monday	PM	13.12	B
Without the presence of Police	Intersection 1	Saturday	AM	14.92	B
	Intersection 2	Saturday	PM	13.62	B
		Sunday	PM	11.79	B
		Monday	PM	19	B
	Intersection 4	Saturday	AM	8.19	A
		Saturday	PM	7.39	A
		Sunday	PM	8.16	A
		Monday	PM	12.68	B

III Results

As the results shown on the table , it can be seen that without the presence of Police the LOS of the intersections is better in comparing with the presence of Police. The reasons of this results are:

1-With the presence of the police , because of the little knowledge about Traffic Engineering, They can not manage the Traffic in the intersections and by changing the Lights and the cycles of intersections , interrupt the flow of traffic and so the saturated flow exist.

2-In this paper the purpose is only focus on the police in intersections and analyze the volume of vehicles in four intersections , the LOS results for the peak traffic of a week is chosen and the days were Saturday , Sunday, Monday , and in these days , the worst case was Saturday evening with LOS of C that is necessary to plan the intersections.

IV Conclusion

In this paper the comparison was taken to show the delays in the intersections and the level of the service in the intersections was used to describe the delays in two cases, with and without the presence of the police . These intersections selected from one arterial street and the specification of these intersections are somehow the same. The result shows that by changing the behavior of police in these intersections with correct training of traffic rules, can improve the traffic and decrease the delays. Because of the little familiarity of some polices, the LOS in the intersections was higher when the police is in the intersections so it is necessary to familiar them with the some parameters of the lights and cycles in intersections to improve the level of service in such intersections in the urban streets.

References

[1] Roess.R.,Prassa. E., Mc Shane , Traffic Engineering book, (Edition 2004 , 2011.).
[2] Highway Capacity Manual 2010.
[3] Webster, F.V. (1958). Traffic Signal Settings. Road Research Technical Paper No. 39.