Analysis of traffic characteristics at signalized crossings of the city of Shivamogga

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***Abstract*— Signalized intersections are given in traffic network systems to improve the effectiveness of vehicular and pedestrian movements. A digital timer indicating the staying red and green time and are regularly embraced in India. The behavior of traffic in the heterogeneous condition of an urban signalized junction is complex. The study is to investigate the parameters which impact the traffic characteristics on countdown timer at signalized intersection under mixed conditions. The investigation is taken by collecting data using videography technique at two signalized junctions of the city.Total of two different approaches was studied in both timers on and off condition. The result observed that saturation flow is not affected by signal timer and start-up loss time (at Mahaveera circle 2.5 to 1.9 and at Shivamurthy circle 3.4 to 2.9sec) reduced in presence of timer.**

Keywords— signalized intersection, countdown timer, start-up loss time

1. INTRODUCTION

In India, due to the presence of heterogeneous vehicles in traffic flow, long cycle lengths are very common at urban intersections. Intersections are necessary foe safer and efficient control of traffic in urban areas. At the signalized intersection different directions of flow share the same road space and flow is segregated in terms of time. Due to this situation traffic flow analyses for signalized intersection is performed in a different way than uninterrupted flow.And it is observed that due to long queue length the vehicles at the intersections, the vehicles do not switch off their engines result in heavy fuel consumption.

Provision of signal countdown timer, a timer showing the remaining red and green time in a phase, is one such measure and is commonly adopted in India. The function of these timers is to help drivers to judge the amount of time left for them to get the green signal for starting (moving) their vehicles. By installing the timer at signalized intersection guide the remaining signal timing available to drivers. Traffic lights or traffic signals are signaling devices positioned at road intersection, pedestrian crossings, and other locations to control traffic flow.Traffic signals are the means by which the controller directs traffic. They tell the road users when to go and when to stop. Traffic signal follows universal traffic signal Colour conventions.

The present study was carried out to analyze the effect of timer at signalized intersection on the vehicle arrivals at the intersections. The study of impact of timer on traffic characteristics such as saturation flow, start-up loss time and volume count distribution were analyzed.

1.1 Scope of the Project

The present work includes the study of effect of countdown timer on various characteristics of traffic at signalized intersections. The study was very much necessary for understanding the behavior of driver and traffic characteristics

Generally in free flow, people will behave in different aspect, if they have signal at the intersections the behavior of people changes and if they have a countdown timer in the signal their behavior depends on that countdown timer, that is what seen in literature and hence it is significant to understand the behavior of driver and traffic characteristics at intersection in presence of countdown timer.

1.2 Objective

The various papers referred were focused moer on the overall behavior of the vehicle users at the signalized intersections in presence of countdown timers. Thus to Study the factors that influence the drivers' behavior and the effect on traffic characteristics when the signal are provided with and without timers will provide a more realistic approach.

2. LITERATURE REVIEW

The present study investigates the effect of timer on traffic. Various researchers have studied the various parameters. Sabyasachi Biswas, Indrajit Ghosh [2] was observed that timers have no significant effect on saturation flow. SULT increased significantly at all the selected locations when timer was switched off. Jeevitha devalla et al.,[4] indicated that reduction in RLV's in presence of timer. The literature gives various parameters that influence traffic characteristics.

3. METHODOLOGY

The present study involves the selection of study area and location for data collection, extracting the data from video footage.

3.1 Study Area Selection

In this study, in order to analyze the influence of signal countdown timer on driver behaviors and traffic characteristics two signalized intersections were selected in Shivamogga district, Karnataka.[Table 1]

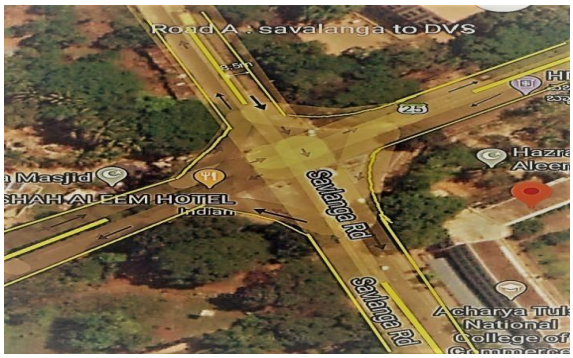

Fig. 1: Study location at Mahaveera circle

Fig. 2: Study location at Shivamurthy circle

TABLE I: CHARATERISTICS OF TRAFFIC LOCATION

Key characteristic	**Intersection 1(IS1)**	**Intersection 2(IS2)**
Location	Mahaveera circle	Shivamurthy circle
Target movements	Through and right turning	Through and right turning
Numberof lanes	2	2
Approach width	8.5m	7.3m
Cycle length	124sec	123sec
Green time	24sec	30sec
Amber time	4sec	3sec
Red time	96sec	90sec

Data collection time	9am to 10 am	9:30am to 10:30am

TABLE II: VEHICULAR COMPOSITION DURING DATA COLLECTION

Characteristics	**Mahaveera circle(IS1)**		**Shivamurthy circle(IS2)**	
Data collection time	9:00 am to 10:00am		9:30am to 10:30am	
Timer condition	On	Off	On	Off
No. Of cycles observed	29	29	28	28
Data collection date	17/02/2020	18/02/2020	13/03/2020	17/02/2020
Vehicle composition (veh/hr)				
Two wheeler	588	639	917	850
Car	150	167	271	244
Auto	96	104	183	155
Bus	48	50	58	53
Truck	7	8	51	48

3.2 *Data Collection*

Data was collected at two signalized intersections in shivamogga district i.e., Mahaveera circle and Shivamurthy circle. Traffic data was collected at the selected intersection by switching off the timer at both the intersection. Data were recorded using camera which are already installed by traffic control room and also manually counts were taken with regular timer.[Fig 3] Video data was collected for one peak hour at each location.

4. ANALYSIS AND RESULTS

For analysis, the data was extracted from the video footages. The data extraction was carried out manually. The traffic volume count data was collected at both intersections namely, Mahaveera circle and Shivamurthy circle. The traffic volume is in vehicles per hour. The traffic volume is converted to PCU values. In India PCU values are adopted from IRC SP 41 code.[Table III]

Fig. 3: Snapshots of Study Location

TABLE III: PCU Values for Different Vehicles

Vehicle type	**PCU values**
Bike	0.5
Car	1
Auto	1.2
Bus	1.5
Truck	2.2

4.1 Effect on Volume Count and Distribution

Traffic volume is the important parameter that affects the road characteristics. In this study we collect the traffic flow volume at both intersections in presence and absence of timer.[Table IV,V]

TABLE IV: TRAFFIC VOLUME DISTRIBUTION AT MAHAVEERA CIRCLE

Location	**Mahaveera circle**			
Vehicle composition	**On**		**Off**	
	(veh/hr)	**(pcu/hr)**	**(veh/hr)**	**(pcu/hr)**

Two wheeler	588	294	639	319.5
Car	150	150	167	167
Auto	96	115.2	104	124.8
Bus	48	72	50	75
Truck	7	15.4	8	17.6
Total	889	646.6	968	703.9

TABLE V: TRAFFIC VOLUME DISTRIBUTION AT SHIVAMURTHY CIRCLE

Location	**Shivamurthy circle**			
Vehicle composition	**On**		**Off**	
	(veh/hr)	**(pcu/hr)**	**(veh/hr)**	**(pcu/hr)**
Two wheeler	917	458.5	850	425
Car	271	271	244	244
Auto	183	219	155	186
Bus	58	85.5	53	79.5
Truck	51	112	48	48
Total	1479	1146.8	1350	1040.1

From the Table IV and V we can see that volume distribution did not change much in presence and absence of timer at both intersections. There is no drastic change in volume distribution, so the traffic flow was not influenced by signal countdown timer.

4.2 Effect on saturation flow and start-up loss time

For saturation flow and start-up lost time investigation, Turner and Harahap had proposed 5 sec as the term of the time cut. Saturation flow is a macro-level indicator of the performance of an intersection operation. It indicates the probable capacity of an intersection if operating under ideal conditions.[Table VI]

TABLE VI: AVERAGE OF VOLUME FLOW FOR ALL 5 SEC INTERVALS OF GREEN AND AMBER

Location	**Mahaveera circle**		**Shivamurthy**	
condition	**on**	**Off**	**on**	**Off**
Flow	Pcu/5 s	Pcu/5 s	Pcu/5 s	Pcu/5
Amber	2.1	1.8	2.1	1.4
0-5 s	5.4	4.5	8.0	4.8
5-10 s	6.9	6.6	7.8	7.1
10-15 s	3.9	5.2	7.5	6.9
15-20 s	3.1	3.7	6.4	6.5
20-25 s	1.8	1.9	5.1	5.6
25-30 s			3.3	3.7

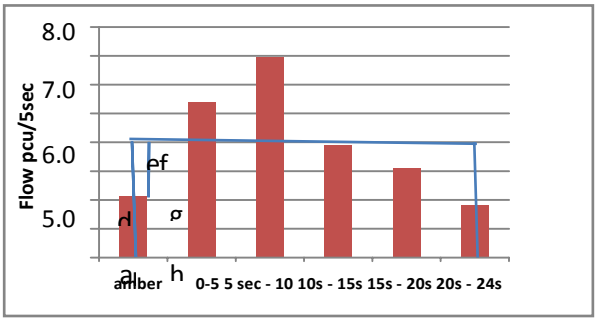

Fig. 4: Typical start up loss time and saturation flow at Mahaveera circle with timer

Form the above graph (Fig. 4), considering, area adgh = area befh or ad x ah = be x bh

Where,

ad = q0, initial traffic flow in the first time interval t

ah = time interval t (5 s)

be = mean saturation flow rate (s), PCU/ t s interval of a particular cycle

bh = effective green in the first interval

Therefore, if ab (which is equal to SULT) is represented as start up loss time.

$$l_s = t - (q0 * t)/s$$
$$= 5 - (2.1*5)/3.9$$
$$l_s = 1.9 \quad (1)$$

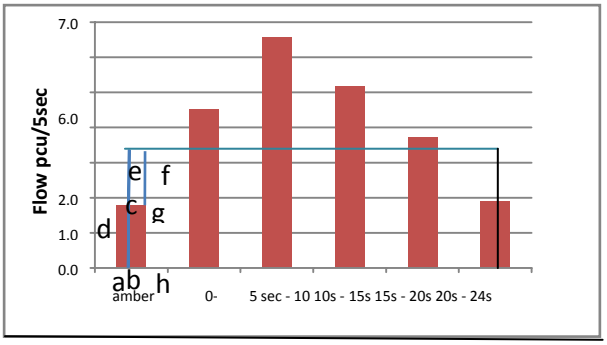

Fig 5: Typical start up loss and saturation flow at Mahaveera circle without timer.

Form the above Fig. 5, considering, area adgh = area befh or ad x ah = be x bh

Therefore, if ab (which is equal to SULT) is represented as start up loss time (same as above calculation in fig 4)

$$l_s = t - (q0 * t)/s$$
$$= 5 - (1.8*5)/3.5$$
$$l_s = 2.5 \quad (2)$$

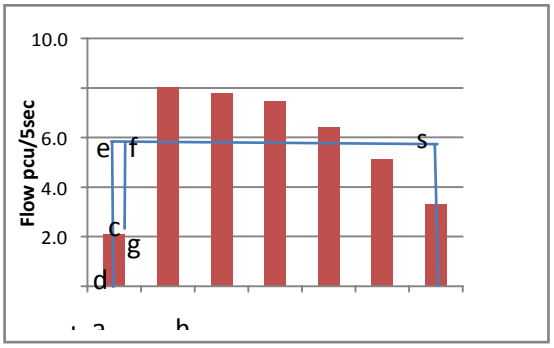

Fig. 6: Typical start up loss and saturation flow at Shivamurthy circle with timer

Form the above Fig. 6 , Considering, area adgh = area befh or ad x ah = be x bh Therefore, if ab (which is equal to SULT) is represented as start up loss time (same as above calculation in fig 4

$$l_s = t - (q0 * t)/s$$
$$= 5 - (2.1*5)/5.1$$
$$l_s = 2.9 \quad (3)$$

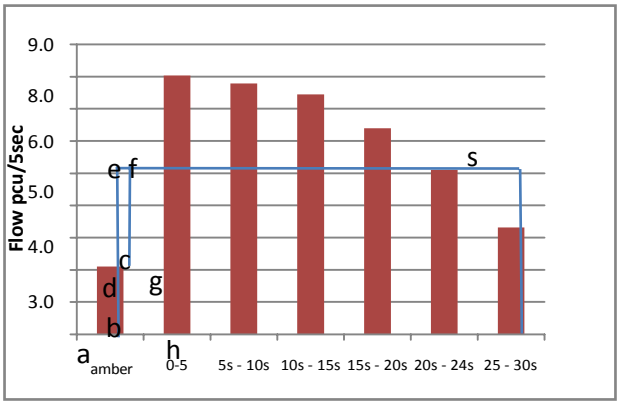

Fig.7: Typical start up loss and saturation flow at Shivamurthy circle without timer

Form the above figure, Considering, area adgh = area befh or ad x ah = be x bh

Therefore, if ab (which is equal to SULT) is represented as start up loss time (same as above calculation in fig 4)

$$l_s = t - (q0 * t)/s$$
$$= 5 - (1.4*5)/4.6$$
$$l_s = 3.4 \quad (4)$$

TABLE VII: START UP LOSS TIME AND SATURATION FLOW CALCULATION AT DIFFERENT APPROACHES

Sl.no	Approach condition	SULT	Saturation flow(pcu/hr)
1	Mahaveera circle(on)	1.9	646.6
2	Mahaveera circle(off)	2.5	703.9
3	Shivamurthy circle(on)	2.9	1146
4	Shivamurthy circle(off)	3.4	1040

The observation from Table VII is that the values of start-up loss time are significantly higher when signal timer turned off for both the intersections. At the Mahaveera circle, the start- up loss time (SULT) is 1.9 second for timer on condition and it is 2.5 for timer off condition. The SULT was significantly increased from 1.9sec to

2.5sec when timer was turned off.

At the Shivamurthy circle, the start-up loss time (SULT) is 2.9 second for timer on condition and it is 3.4 for timer off condition. The SULT was significantly increased from 2.9sec to 3.4sec when timer was turned off.

5. CONCLUSIONS

This paper observation explains the effects of the signal cycle timer on traffic characteristics at two signalized intersection in shivamogga, both with and without of timer. It was observed that volume distribution did not change much in presence and absence of timer at both intersections. There is no drastic change in volume distribution, so the traffic flow was not influenced by signal countdown timer [Table V and Table VI]. The SULT was significantly increased from 2.9sec to 3.4sec when timer was turned off. The signal timer is significantly effect the start-up loss time [Table VII).

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REFERENCES

[1] Bharat K Pathivada a, Vedagiri Perumal "Modelling Driver Behaviour in Dilemma Zone under Mixed Traffic Conditions" EWGT, September 2017

[2] Sabyasachi Biswas, Indrajith Ghosh and Sathish Chandra, "Effect of countdown timer on traffic characteristics and driver behaviours at signalized intersection" IIT Roorkee,November 10,2015

[3] Sharma A., Vanajakshi, L., and Rao, N."Effect of Phase Countdown Timers on Queue Discharge Characteristics under Heterogeneous Traffic Conditions". Transportation Research, 2009

[4] Jeevitha devalla, sabyasachi biswas, indrajith ghosh "the effect of countdown timer on the approach speed at signalised intersection" ABMTRANS 2015

[5] Sabyasachi Biswas* and Indrajit Ghosh** "Modelling of the Drivers' Decision-Making Behaviour During Yellow Phase" IIT Roorkee, July 7, 2018

[6] Sabyasachi biswas, indrajith ghosh, sathish Chandra "Influence of Signal Countdown Timer on Efficiency and Safety at Signalized Intersections" January 2017.

[7] Anuj Sharma, lelitha vanajakshi, v. Girish "Impact of Signal Timing Information on Safety and Efficiency of Signalized Intersections" university of Nebraska, 2012

[8] Gazis, D., Herman, R., and Maradudin, A. "The Problem of the Amber Signal Light in Traffic Flow", Operations Research, 8(1), 112–132. 1960

[9] Harshitha, M. S., Agarwal, S., and Vanajakshi, L. "Headway Analysis at Signalised Intersections with and without Countdown Timer". Highway Research Journal, January, 3,2012

[10] Lorella Grepo, Lancelot Yupingkum . "Traffic Light displays and Drivers Behaviors : A Case Study", University of wisconsin, December 2015

[11] Carroll J. Messer, Srinivasa R. Sunkari, Hassan A. Charara, and Ricky T. Parker. "Development Of Advance Warning Systems For End-Of-Green Phase At High Speed Traffic Signal" Texas Department of Organisation, January 2004

[12] Mohammad R. Islam, Amy A. Wyman, David S Hurwitz. "Safer Driver responses at Intersection with Green Signal Countdown Timer" Oregon state university, August, 201

[13] Shiaw Yin Yong, "Investigating Drivers Behavior on approaching Junction at the End of Green Time" university Brunel Darussalam, January 2014

[14] Rijavec, R., J. Zakovšek, and T. Maher. " Acceptability of Countdown Signals at an Urban Signalized Intersection and Their Influence on Drivers Behaviour" 1, 2013

[15] Zhang, Zhang, S. Wenbo, H. Zhaocheng, X. X. Feifei. "Exploring Impacts of Countdown Timers on Queue Discharge Characteristics of Through Movement at Intersection" 2013

[16] Gazis, D., R.Herman, and A.Maradudin."The Problem of the Amber Signal Light in Traffic Flow". Operations Research, Vol. 8, No. 1, 1960

[17] Arsonson, P. S., R. W. Roseveare, and J. M. Thomas. "Small Aare Detection at Intersection Approaches",Journal of Transportation Engineering, 1974

[18] Bonneson, J.A., P.T.McCoy, "Traffic Detector

Design and Evaluation Guidelines- Final Roport",Nebraska Department of Road 1994

[19] Papaioannou, P. "Driver behaviour, dilemma zone and safety effects at urban signalized intersections in Greece. Accident; analysis and prevention" Jan. 2007

[20] Kidwai, F. A., M.R.Ibrahim, and M. R. Karim. "Traffic Flow Analysis of Digital Count Down Signalized Urban Intersection".Journal of Mathematics and Technology, 2005

[21] Lum, K. M., and H. Halim. "A Before and After Study on Green Signal Countdown Device Installation". Transportation Research, January 2006

[22] M. R. Ibrahim, M. R. Karim and F. A. Kidwai "The Effect of Digital Count-Down Display on Signalized Junction Performance"American Journal of Applied Sciences 5 (5): 479-482, 2008 ISSN 1546-9239 © 2008 Science Publications

[23] Fuquan Pan ,1 Lixia Zhang ,1 Changxi Ma ,2 Haiyuan Li,3 Jinshun Yang,1 Tao Liu,1 Fengyuan Wang,1 and Shushan Chai 1Impact of Vehicular Countdown Signals on Driving Psychologies and Behaviors: Taking China as an ExampleVolume 2017 |Article ID 5838520

[24] Quan Yu,Hui Zhang,Jian Rong,Jin-guang Liu "The analysis of traffic flow characteristics at signalized intersections" 2nd International Conference on Power Electronics and Intelligent Transportation System (PEITS)-2009

[25] Jun-Wei Zeng, Sen-Bin Yu,Yong-Sheng Qian, Xu-Ting Wei, Xiao Feng and Hui Wang"Research on traffic flow characteristics at signal intersection" Modern Physics Letters BVol. 31, No. 26, 1750238 (2017)