

Performance Analysis of Traffic Signal Connecting to Jalahalli Cross-Bengaluru

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ABSTRACT: Road transportation network is significant backbone of current society with the increasing demand of mobility. Traffic controlling is a big challenge in many cities, especially growing cities. Since the capacity of traffic throughout is limited in urban area, it is critical to improve the capacity of traffic network. Traffic signals controlling as an elementary component of all the road transportation system and it is used to solve this problem of traffic conflict on intersections. The performance of traffic flow through intersections depends on the phases, sequence and the timing of traffic signals. Therefore, efficient traffic signal operation is vital for smooth traffic flows in signalized network, and well-maintained signal operation is greatly beneficial for road users. Traffic volume studies are to be made to determine the number, movement and classification of vehicles at the given location. These data is used to identify normal flow of the road, determine the influence of heavy vehicles or pedestrians on vehicular traffic volume. The length of the sampling period depends on the type of count being taken. The collected data is converted into PCU units. Webster's method is a rational approach for signal design. The design is simple and is totally based on formulae's laid down by Webster. In this method, the total cycle of the signal is determined which forms a total least delay occurring at signal. A critical work for the thesis is to select suitable and useful measurements of signal performances based on available traffic data at jalahalli cross- Bengaluru.

KEYWORDS: Traffic, Traffic signal, Load factor, Webster

I.INTRODUCTION

Traffic congestion is a severe problem at an intersection in urban, having been causing many critical problems and challenges in major and most populated cities around the world. The problems of urban transportation are well known not just for traffic engineers but to people in all walks of life. Overcrowded and congested with vehicles of all type creating lots of traffic problems and pollutions making the cities a veritable jungle. The problem as exist today can hardly be linked from its problem of town planning and its implementation. In fact bottlenecks in the urban transportation system have risen because the cities are not planned and built for supporting the volume of population they are given shelter today. Travel has become inherently risky activity in cities. Traffic consists on Indian roads of bi-directional freedom traffic such as two or three wheeled vehicles and unit -directional vehicles such as four wheelers. Or rejected by various modes of traffic. To prevent traffic accidents, conflicting traffic streams are separated either in space or in time.

Intersections are important part of a road section. When provided without any proper traffic control measures they end up with congestion and bottlenecks. So, to prevent this issue, these should be designed on the aim of decreasing it has been observed during this study that many intersections in Bangalore have become inadequate to handle the present day traffic causing congestion, delays, bottlenecks and accidents particularly during the peak hours as the traffic control system installed on these intersections are pre timed.

Indeed, signal timing is the technique to appropriately decide the signal cycle and effective green time or other factors, with respect to various intersections, phases, traffic flows and others obtained.

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II. LITERATURE SURVEY

[1] **B. Sudharshan Reddy, N. et.al. (April 2016)** carried a study on “signal design for t - intersection by using Webster's method in Nandyal town, Kurnool district of Andhra Pradesh” and they conclude that Based on the calculations done on the PCU values obtained from the traffic survey the signal cycle length for morning session is 83 sec for afternoon session is 145 sec and for evening session 65 sec. by providing signals there will be reduction in the conflicts. And also there will be an orderly moment of traffic in the crass section for the roads from bus stand to words Atmakur, Srisailam, Kurnool, Kadapa, Allagtadda and Srinivas enter to words bus stand, Bommalasathram. As well, there is no necessary of traffic police to regulate the traffic at Sanjeevenagar gate.

[2] **Ishanth Sharma, Dr.Pardeep k. Gupta et. al. (July 2015)** carried a study on “study of automatic traffic signal system for Chandigarh” and they concluded that It can be concluded that the by replacing the pretimed Traffic signals with the automatic traffic signals, capacity is being increased and LOS is also being improved. Detector technology to be used for the detection of vehicles is Inductive loop which is commonly used and simple to install, operate and maintain. When pretimed traffic signals fail to clear off the intersection traffic police have to clear off the intersection by turning off the traffic signals and handling the traffic manually on their own. This problem can be solved by placing automatic traffic Signals. As automatic signals are saving the wasted time and increasing the capacity the expensive part can be tolerated and hence they can be provided at Intersection. After 3 years Webster's method of signal design fails to design the signal for the traffic as the value of Y comes greater than 1. So at this situation automatic traffic signals comes into play as they will be detecting real-time traffic and assigning the green time for the approach lanes to clear off the traffic.

[3] **VeethikaGomasta, MohitMalviya et.al. (December 2015)** carried a study on “design and analysis of intersections for improved traffic flow at Bhopal case studies of Jyoti talkies square and Vallabhbhavan roundabout” And they concluded that the current cycle length in afternoon peak hours is less than required. Capacity of Vallabhbhavan about 3017 PCU/hr.> 3000 PCU/hr. requires traffic signal cycle time of 140 sec.

[4] **Dr. Tom V. Mathew et.al. (February 2014)** carried a study on “design principles of traffic signals” and they concluded that Traffic signal is an aid to control traffic at intersections where other control measures fail. The Signals operate by providing right of way to a certain set of movements in a cyclic order. The design procedure discussed in this chapter includes phase design, interval design, determination of cycle time, computation of saturation flow, and green splitting.

[5] **Dr. Tom V. Mathew et. al. (February 2014)** carried a study on “vehicle actuated signals” and they concluded that Modern actuated controllers give the traffic engineers a great deal of flexibility in dealing with variations in demand. Area traffic control system along with Vehicle actuated signals can reduce traffic delays substantially. These are highly complex subject. Timing of VA signals is almost as much an art as a science, and more than one solution is possible. Regarding ATC systems, SCOOT and SCAT are popular in advance countries but such systems cannot cope up with Indian situations without adaptation to Indian traffic scenario. Presently, an advance ATC system known as CoSiCoSthas been developed considering the Indian Traffic scenario.

[6] **Lin dong, Wushan Chen et.al. (July 2010)** carried a study on “real - time traffic signal timing for urban road multi-intersection” And they concluded that the paper developed the real-time signal timing model (non-fixed cycle and non-fixed split) to relieve the traffic Congestion. Introducing the release matrix to analyse the situation of traffic flow, the basic model was proposed to minimize total delay time of vehicles. Then, the optimal Real-time signal model was realized by combining the Webster split optimal model. Finally, based on simulated data using Passion distribution, result was showed that the non- fixed cycle, non-fixed split” model out performance and is more cost effective than “fixed cycle, fixed split” model and “fixed cycle, non-fixed timing”. This research gives useful suggestions on signal control to prevent the Traffic congestion.

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III. OBJECTIVES AND METHODOLOGY

➤ **OBJECTIVES**

1. Investigate the effects of phase green split variation of traffic signals on the existing traffic at Jalahalli cross.
2. Redesigning the signal systems as per requirement of traffic plying at Jalahalli cross.

➤ **METHODOLOGY**

1. Analyzing the performance of the existing traffic signal systems.
2. Traffic volume studies on each leg.
3. Pedestrian volume count on major road.
4. Load hour factor studies.
5. Analyzing level of service of the existing signal systems.
6. Redesigning the signals for existing traffic using Webster's method of signal design.

IV. RESULTS AND DISCUSSIONS

➤ **EXISTING SIGNAL DISCIPLINE AT JALAHALLI CROSS:**

ROAD NAME	GREEN TIME (SEC)	RED TIME (SEC)	AMBER TIME (SEC)
8 TH MILE TO YASHWANTHPUR	60	180	8
YASHWANTHPUR TO 8 TH MILE	60	180	8
YELAHANKA TO T.V.S CROSS	30	130	8
T.V.S CROSS TO YELAHANKA	30	130	8

Table 1: Signal discipline at Jalahalli cross

Signal discipline, from 8th mile to Yashwanthpur and Yashwanthpur to 8th mile is of total cycle length 248 seconds in which green time is 60 seconds, red time is 180 seconds and amber time is 8 seconds. Similarly signal discipline from Yalahanka to TVS cross and TVS cross to Yalahanka is of total cycle length 168 sec in which green time is 30 sec, red time is 130 sec and amber time is 8 sec.

➤ **TRAFFIC VOLUME COUNT AT JALAHALLI CROSS DURING PEAK HOURS:**

ROAD NAME	TRAFFIC VOLUME COUNT PCU/HOUR	TRAFFIC VOLUME COUNT PCU/HOUR
8 TH MILE TO YASHWANTHPUR	5650	5900
YASHWANTHPUR TO 8 TH MILE	5300	5850
YELAHANKA TO T.V.S CROSS	6650	6900
T.V.S CROSS TO YELAHANKA	6050	6700

Table 2: Traffic volume in Jalahalli cross

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The number of vehicles crossing the Jalahalli cross junction is noted during the peak hours for 7 days and it is converted into PCU values. The average number of vehicles passing from 8th mile to Yeshwanthpur during the peak hours 5775 PCU/hr. The average number of vehicles passing from Yeshwanthpur to 8th mile during the peak hours 5575 PCU/hr. The average number of vehicles passing from Yelahanka to TVS cross during the peak hours 6775 PCU/hr. The average number of vehicles passing from TVS cross to Yelahanka during the peak hours 6375 PCU/hr.

➤ NORMAL TRAFFIC FLOW AT JALAHALLI CROSS:

ROAD NAME	TRAFFIC VOLUME COUNT PCU/HOUR
8 TH MILE TO YASHWANTHPUR	1200
YASHWANTHPUR TO 8 TH MILE	1550
YELAHANKA TO T.V.S CROSS	1450
T.V.S CROSS TO YELAHANKA	1500

Table 3: Normal traffic flow at Jalahalli cross

Normal traffic flow means the number of vehicles passing during the non-peak hours. The normal traffic flow for the stretch 8th mile to Yeshwanthpur is 1200 PCU/hr. and for Yeshwanthpur to 8th mile is 1550 PCU/hr. The normal traffic flow for the stretch Yelahanka to TVS cross is 1450 PCU/hr. and for TVS cross to Yelahanka is 1500 PCU/hr.

➤ LOAD FACTOR ANALYSIS:

ROAD NAME	LOAD FACTOR= Fully utilized cycle/ total number of cycles	LEVEL OF SERVICE
8 TH MILE TO YASHWANTHPUR	1	F
YASHWANTHPUR TO 8 TH MILE	0.5	D
YELAHANKA TO T.V.S CROSS	1	F
T.V.S CROSS TO YELAHANKA	0.8	B

Table 4: Load factor values

Load factor is the main criteria for deciding the level of service. It is the ratio of fully utilized cycles to total number of cycles. The level of service is obtained from HCM (highway capacity manual). For the road 8th mile to Yeshwanthpur the load factor value is 1 and the level of service is F which indicates unavoidable traffic and jamming condition. For the road Yeshwanthpur to 8th mile the load factor value is 0.5 and the level of service is D which indicates Approaching unstable flow, delays but excessive back up do not occur. For the road Yelahanka to TVS cross the load factor value is 1 and the level of service is F which indicates unavoidable traffic and jamming condition. For the road TVS cross to Yelahanka the load factor value is 0.8 and the level of service is B which indicates Stable flow, sometime approach phase is fully utilized.

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➤ **PROPOSED SIGNAL TIME AT JALAHALLI CROSS ACCORDING TO WEBSTER’S METHOD OF SIGNAL DESIGN:**

ROAD NAME	GREEN TIME (SEC)	RED TIME (SEC)	AMBER TIME (SEC)
8 TH MILE TO YASHWANTHPUR	80	255	3
YASHWANTHPUR TO 8 TH MILE	90	251	3
YELAHANKA TO T.V.S CROSS	80	255	3
T.V.S CROSS TO YELAHANKA	75	266	3

Table 5: Proposed signal time as per Webster method of signal design

The level of service in Jalahalli cross junction is not satisfactory which is obtained from load factor analysis and hence the signals in Jalahalli cross junctions are redesigned by Webster method. The results are as follows for the road 8th mile to Yeshwanthpur the total cycle length is updated to 338 sec from which green time 80 sec, red time 255 sec and amber time is 3 sec. For the road Yeshwanthpur to 8th mile the total cycle length is updated to 344 sec from which green time 90 sec, red time 251 sec and amber time is 3 sec. For the road Yelahanka to TVS cross the total cycle length is updated to 338sec from which green time 80 sec, red time 255 sec and amber time is 3 sec. For the road TVS cross to Yelahanka the total cycle length is updated to 344 sec from which green time 75 sec, red time 266 sec and amber time is 3 sec.

V. CONCLUSION

1. The average traffic volume operating from 8th mile to Yashwanthpur and Yashwanthpur to 8th mile is 1325 PCU/hr. and saturation value is 5650 PCU/hr.
2. The average traffic volume operating from TVS cross to Yalahanka and Yalahanka to TVS cross is 1525 PCU/hr. and saturation value is 6550 PCU/hr.
3. According to the load factor analysis the junction is operating with level of service D and F, hence forced flow and jammed condition is the current situation at the junction.
4. Green phase time in Jalahalli cross is updated from 248 seconds to 325 seconds according to Webster’s method of signal design for the existing traffic.
5. By incorporating above cycle length level of service may be increased from F to B.

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