

Traffic volume and signal synchronizations from overbridge to Attakulangara in Trivandrum, Kerala

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Abstract: The road transportation increases year by year, but the rate of road crashes also increases with it. India is one of the developing countries, where the rate of road crashes is more than the critical limit. According to manual count with 15-minute intervals could be used to obtain the traffic volume data. The collected data is converted into PCU units. The synchronization of traffic light systems is one of the best solutions in order to avoid problematic traffic jams. One of the common causes of traffic jams is because of non-synchronized traffic light systems. Once a light turns green, traffic begins to move, but by the time the moving traffic reaches the next light, the signal is still red. This will disrupt the continuity of the traffic flow, especially for large main roads. The smooth flow of traffic on main routes is important to clear dense traffic in a given time. 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. The outcomes of this study support the hypothesis that retiming traffic lights to create a synchronized traffic light system for main roads will greatly improve traffic flow.

Keywords - Intersections; PCU; road safety; traffic control

I. INTRODUCTION

Transportation is involved with the movement of people and material from one place to other i.e. from origin to destination. Transportation creates place and time utility for goods for both finished and raw, but also ensuring that the right kinds of goods are available at the right time. Road accidents are considered to be as a serious issue of concern in the present era. The increasing vehicle population and inadequate serviceability of the existing roads had resulted in a large number of fatalities in roads. Road accidents now leads the list of accidental deaths in India much more than any other such as by drowning, fire, rail or air mishaps etc makes road safety an important consideration and objective of Civil Engineers. Road safety refers to the methods and measures that are related to reduce risks of injury, death and harm to drivers, passenger and pedestrians. The provision of signal at the intersection is one of the methods to control the traffic, signal permits the leg wise movement of the traffic and

synchronization is the coordination between relative signals. In congested parts of the cities, traffic control at road intersection in practical and economical only with the help of

traffic signals under the prevailing conditions. The hypothesis of this study was that an improved traffic light system will lead to better traffic management and, therefore, more peaceful urban areas. On obtaining the Traffic Signal Synchronization at intersection is to clear maximum number of vehicles through the intersection in a given length and time with least number of accidents, at maximum safe speed and with minimum delay.

II. OVERVIEW OF ROAD ACCIDENT STATISTICS

A. World Scenario

Overall, between 2010 and 2014, the number of road fatalities declined by 8.8% in the 32 member countries of the *International Road Traffic and Accident Database (IRTAD)* for which data are consistently available. However, in 2015, the number of road deaths increased in at least 19 countries. After going through few reports we came across different causes of road accidents which have to be considered for the welfare of people. Distracted drivers are the top cause of car accidents around the world. An environmental factor like heavy rain creates slick and dangerous surfaces for cars, trucks and motorcycles. Geometrical factors like unsafe lane changes, potholes, deadly curves.



Source: International Transportation Forum
Fig No 1 Road Accident Statistics –world wide

In 2014, for the 32 IRTAD member countries for which data are consistently available, it is noted that there is a decrease of 1.3% in road fatalities from 2013 and an 8.8% decrease from 2010. The decrease in 2014 was however much lesser than the 2.3% average annual reduction seen over the last five years(2010-2014). When compared to 2014 accidental data, 2015 data shows huge decrement.

B. Indian Scenario

India has a road network of over 54,72,144 km which is mentioned as the second largest road network in the world. In 2015 India population was 127 crores. The below given tabulation represents the vehicle growth along with the accident growth rate.

Table No 1 Road Accident Statistics in India
 Growth in Number of Vehicles and Road Accidents in India (2011-2015)

Sl. No.	Year	Road Accidents (in thousand)	% Variation over Previous Year	Persons Injured (in thousand)	% Variation over Previous Year	Persons Killed (in Nos.)	% Variation Over Previous Year	No. of Vehicles (in Thousand)#	% Variation over previous Year	Rate of Deaths per thousand Vehicles (Col.7/ Col.9)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	2011	440.1	-	468.8	-	1,36,834	-	1,41,866	-	1.0
2	2012	440.0	-0.02%	469.9	0.2%	1,39,091	1.6%	1,58,491	12.4%	0.9
3	2013	443.0	0.7%	469.9	0.0%	1,37,423	-1.2%	1,82,445	14.4%	0.8
4	2014	450.9	1.8%	477.7	1.7%	1,41,526	3.0%	1,82,445*	-	0.8
5	2015	464.6	3.0%	482.3	1.0%	1,48,707	5.1%	1,82,445*	-	0.8

Source: NCRB (National Crime Records Bureau)

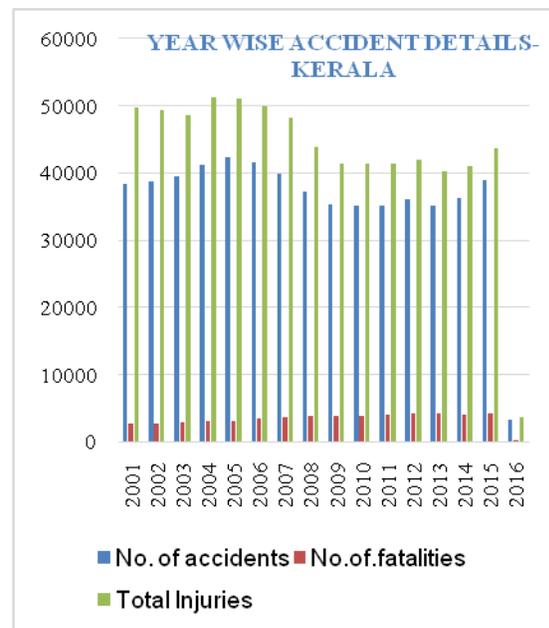
C. Kerala Scenario

Annually, road accidents records in Kerala are about 4000 deaths and 40,000 injuries. In the Indian population, Kerala accounts for only 3% of population whereas its contribution towards road accidents is about 10%. Annually, in the road accidents 84% of males were killed and 82% of males were severely injured in road accidents. But in the state of Kerala more than half of the road accidents are in the age group of 22 to 55 because of the increasing demand for two wheelers

among youth and also due to the aggressive driving behavior. It is estimated that 11 people die and 150 people get injured per day. About 45% of accidents take place in NH and SH. Due to road accidents 80% of pedestrians and bike riders were subjected to death annually.

D. Background of study

Thiruvananthapuram is the capital city of Kerala which is referred as Ever Green city of India. The co-ordinates of Thiruvananthapuram is 08°29'15"N 76°57'9"E. The region covers an area of about 214.86 Km². This city is a trading post of spices, sandal wood and ivory. It is a major tourist destination popularly known for the famous Padhmanabham Swamy Temple. It is one of the fastest developing cities in south India. On comparing the accidental data of all districts in Kerala, we could see that Thiruvananthapuram is a region that needs to be studied because of its huge volume of traffic and pedestrians. Due to these reasons, Government had already launched various road safety measures. After the successful implementation of the road safety measures, these measures were not evaluated to check its effectiveness. Thus this city has been chosen for study to evaluate the impacts of road safety initiatives implemented.



Source: SCRB (State Crime Records Bureau)

Fig No 2 Road Accident Statistics in Kerala

This statistical report from SCRB (State Crime Records Bureau) clearly states that in Thiruvananthapuram during 2016 about 1673 number of accidents occurred in which 118 people were reported to be died and no people were reported to be grievously injured. After going through the statistical data, we came to know that on comparison with the data corresponding to 2016, the number of accidents and fatalities in Thiruvananthapuram showed a huge variation. Thus this factor made us to choose this city with a particular stretch to evaluate the road safety measures which decreased the accidents and fatalities in Thiruvananthapuram than previous years.

III. LITERATURE REVIEW

Review of literature is important in any research work. Many researchers have carried out research work in the area of road accidents. Some of them have analyzed accident data in different ways. Even though a large number of literatures are available in the field of road safety, a few of them were found to be dealing with the impacts of the implemented road safety measures on the society. Some of the studies are listed below.

Singh, A.P.et.al (2009), conducted a study on Road safety improvements, on entire Indian roads. They gathered details regarding factors contributing to the road accidents, their trends like death rates between 2004 and 2008, type and percentage of injuries. They suggested that education, enforcement of law, engineering, environment and emergency care of road accident victims could prevent and control road accidents

The study also suggested some recent approaches to road safety like traffic segregation, to provide high quality road system with increased length of divided highways which have a better safety record than before and to reduce speed of vehicles in urban areas.

Dr.S.S.Jain.et.al (2011) conducted road safety auditing on all the important four lane National highways in India. They conducted a spot speed survey and also collected data about traffic volume, percentage of growth rate of motor vehicles and accidental details. After the process of data collection they suggested that "Service Roads" should be provided to separate slow moving vehicles and fast moving traffic, to close the unauthorized median openings and finally to provide pedestrian guardrail along the foot path, road service and bus stops.

In the past several decades, a variety of models have been developed to solve complex traffic and transportation engineering problems. Some traffic signal synchronization strategies have been applied practically, and others are still in the research stage. It is by now well established that traffic signal synchronization is an effective measure for reducing traffic congestion hence a great effort has been made in the area of signal timing optimization techniques. Most of these control strategies are based on fixed-time signal control, including Webster's model, semi graphical model, Pontryagin's control model, and store and forward model. Clearing of the given volume of traffic at green lights was major issues at major cities especially during peak hours and non-peak hours.

Synchronization conducted in Alicia Parkway-California in the year 2007 for a stretch of 17.7 km road which has 41 intersections. The improvement include upgrade to traffic management system, intersection traffic signal controls, new optimized signal timing. The study was conducted morning, mid-day and evening on weekdays and weekends. The objective of this study was to find travel time in minute, no of stops. It was found that after synchronizing, the number of stops reduced by 75 % during morning and evening hours. Average speed increased by as much as 31 %.

Mr-10 road Indore synchronization done for 8.4 km with 2 intersections with the help of video graphic method. The study

was done during peak hour 8-11 am and 5-8 pm for 7 days. The major objective was to clear maximum number of vehicle through intersection in given time with least no of accidents, maximum safe speed and minimum delay. All intersection signal design was based on Weber's method. And it results in an increase of traffic capacity and reduced delay. It also reduced the journey time.

Similar studies were conducted on Jalan Bukit Gambier, Penang, Malaysia & Eastern Ring Road in the year 2014. It showstraffic congestion served as severe problems at intersections and created many critical problems like traffic jam, delay, pollution, accidents etc. Due to more traffic jam the delay of vehicles is more. Excessive fuel is loss due to low running speed and delays. Practical procedures or guidelines for signal timing of saturated network are not readily available. SCOOT, for example, has performed well in moderate traffic conditions but has shown major deficiencies in saturated and highly fluctuating conditions. In addition, it is proved that SCATS is more effective at reducing delay during low volume periods than high volume periods.

"The Benefits of Retiming Traffic Signals" presented in the year 2005 by Harris J shows signal retiming provides significant direct benefits for the travelling public. One of these benefits is the reduced delay experienced by motorists. Delay savings are more apparent for motorists travelling along coordinated signalized arterials. Improved signal timing also has indirect benefits. Better coordination along major arterials minimizes the diversion of traffic to local and residential streets, improving safety and traffic conditions. It also leads to reduced fuel consumption, reduced emissions, and improved air quality.

In order to ascertain whether neighboring intersections can be effectively coupled on the basis of traffic behavior, observational information on vehicular platoons was collected by John A Hiller in the year 1967 for sites London, England. This information is analyzed with particular emphasis on the phasing of neighboring intersections for minimum delay. At each of the four sites studied, arrival time data was collected at four positions downstream from the signalized intersection from which the vehicular platoons were emerging. This data gives a measure of how platoons diffuse as they move from one intersection to the next. The analysis indicates that the diffusion process can be taken into account in the setting of signal. In particular, total delay in vehicle- hours per hour green as a function of offset time is calculated, and in turn, the optimal offset time that would minimize delay is shown to be a linear function of the distance from the issuing traffic signal.

SCOPE OF THE STUDY

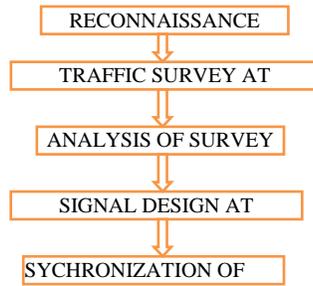
The aim is to evaluate the impacts of the road safety initiatives in the given stretch and to synchronize the traffic signals from the link volume data collected.

IV. OBJECTIVE OF THE STUDY

- To evaluate and analyze the road safety initiatives implemented by Kerala Government.
- To categorize the road safety initiatives in terms of Non-engineering & Engineering aspects.
- To have minimum overall delay to traffic streams, both in the main and side roads.
- To prevent the queue of vehicles at one intersection from

extending and reaching the intersection.

➤ **METHODOLOGY**



IV.CONCLUSION

Based on the calculations done on the PCU values obtained from the traffic survey, the Signal Cycle Length for morning and evening session was calculated. By providing signals, there will be reduction in the conflicts. And also there will be an orderly movement of traffic in the cross-section for the roads from Overbridge Junction to Attakulangara. As well, there is no necessary of traffic police to regulate the traffic at intersections.

ACKNOWLEDGEMENT

We would like to express our sincere appreciation and thanks to Dr. B.G. Shreedevi, Director, National Transportation Planning and Research Centre, Thiruvananthapuram, for giving permission and providing all necessary facilities for undergone project work in NATPAC. We sincerely express our gratitude and indebtedness to our external guides Shri. R. J. Sanjai, Technical Officer and Shri.

Sreenath, Project Engineer, NATPAC, Thiruvananthapuram, for his invaluable advice and inspiring guidance in carrying out this work.

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