ISSN (Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization, Volume3, Special Issue 6, February 2014

National Conference on Emerging Technology and Applied Sciences-2014 (NCETAS 2014)

On 15th to 16th February, Organized by

Modern Institute of Engineering and Technology, Bandel, Hooghly 712123, West Bengal, India.

Effect of Control Delay in Traffic Control and Management of Arterial At-Grade Signalize Road Intersections

Sukanta Karati[1], Amartya Ray[2]

Assistant Professor, Department of Civil Engineering, Modern Institute of Engineering & Technology, Bandel, Hooghly, West Bengal, India [1]

3rd Year Student (B.Tech), Department of Civil Engineering, Modern Institute of Engineering & Technology, Bandel Hooghly, West Bengal, India [2]

ABSTRACT: This paper is an attempt to address the control delay in traffic control and management of arterial at-grade signalised road intersection. Delay is the one way to measure the interruption traffic flow. Control delay is defined as the total delay, which is occurred at signalised intersection. Control delay depends on types of signal as well as cycle time of signal, degree of saturation, queue of vehicles, peak factor, progression factor and condition of carriageway and geometric features of pavement. Control delay includes initial deceleration delay, queue move-up time, stopped delay and final acceleration delay. The length of average control delay can be found out to use an equation at various signalized intersection. To objectives of this research study were to analyse difference way to minimize the control delay and maintain the rapid flow, to improve the speed of vehicle, increase the traffic carrying capacity and remove traffic congestion.

KEYWORDS: At-grade, arterial, interruption flow, queue, control delay

I.INTRODUCTION

The urban streets carry large traffic volumes for vehicles which they were not simply designed. The inevitable result is delay, congestion and lack of safety. The delay is critical performance measure on interrupted - flow facilities. The delay at an intersection is defined as the difference in travel time experienced by a vehicle as it is affected and unaffected by the traffic control at an intersection. It includes the “lost” time due to deceleration and stopped delay (May, 1990). The stopped delay includes queue delay at oversaturated intersections and unnecessary stopped delay defined as the portion of the stopped delay which occurs when there is no vehicle entering an approach on the opposing legs of the intersection (Taylor, and Young, 198). The variation in traffic flow between two different periods could be sufficient to mask the difference in delay between the before and after periods. It also found that delay is difference in different approach at a signalized intersection.

There are several types, but in this paper control delay is the principal service measure for level of service at signalised intersections. Control delay involves movements at slower speeds and stops on intersection approaches, as vehicles move up in the queue or slow down upstream of an intersection. Drivers frequently reduce speed when a downstream signal is red or there is a queue at the downstream intersection approach. It requires the determination of a realistic average speed for each roadway segment. Control delay is the portion of the total delay attributed to traffic signal. Control delay includes movements at slower speeds and stops on intersection approaches as vehicles move up in queue position or slow down upstream of an intersection. Control is the summation of uniform delay, incremental delay and initial delay with respect to progression factor.

Uniform Delay: Uniform delay is another type of delay which is occurred in presence of uniform arrivals, stable flow, and no initial queue. It is based on the first term of Webster’s delay formulation and is widely accepted as an accurate depiction of delay for the idealized case of uniform arrivals.

ISSN (Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization, Volume3, Special Issue 6, February 2014

National Conference on Emerging Technology and Applied Sciences-2014 (NCETAS 2014)

On 15th to 16th February, Organized by

Modern Institute of Engineering and Technology, Bandel, Hooghly 712123, West Bengal, India.

The incremental Delay: Incremental delay is other type of delay which occur at signalized intersection due to non uniform arrivals and temporary cycle failures (random delay) as well as delay caused by sustained periods of oversaturation (oversaturation delay). It is sensitive to the degree of saturation of the lane group, the duration of the analysis period (T), the capacity of the lane group, and the type of signal control, as reflected by the control parameter. The equation assumes that there is no unmet demand that causes initial queues at the start of the analysis period.

Initial Delay: It also occurs at the signalized intersection. When a residual queue from a previous time period causes an initial queue to occur at the start of the analysis period (T), additional delay is experienced by vehicles arriving in the period since the initial queue must first clear the intersection. This procedure is also extended to analyse delay over multiple time periods, each having a duration T, in which an unmet demand may be carried from one time period to the next. If this is not the case, a value of zero is used for initial delay.

II.EVALUATION AND METHEODOLOGY

An intersection is a prime location of the road networks where two or road connect each other and conflict points are generated and control delay is occurred here. These conflict points are more concern elements in traffic control & management system. The efficient intersection control means how efficiently these conflict points are avoided or eliminated in vehicular as well as pedestrian movements during the operational condition. The traffic safety at the inter section of the urban arterial roads are the key issues related to safe, orderly and efficiently traffic control management system for both vehicular as well as pedestrians. The ingredients that constitutes the level of service which depends on delay parameter, at urban signalized intersections are its geometric features, condition of traffic movements as well as compositions, pedestrian volumes & natures, location of intersections, traffic control mechanism like traffic signal, traffic sign & marking, pedestrian cross over etc. and the frequency of intersection of that network. An ideal traffic delay study includes the study of the existing intersection in terms of the intersectional geometric design and signalling design system and its operation.

Many different analysis techniques for the calculation of intersection delay had been developed (McShane, and Roess, 1990). But in this paper the control delay is found out to use the equation according to Highway Capacity Manual. Control delay is summation of difference delay i,e initial delay, uniform delay, incremental delay. Accessories data is collected by manually of signalized intersection at Kolkata. The average control delay per vehicle for a given lane group is determined by this equation.

$d = d_1(PF) + d_2 + d_3$

Where;

d = control delay per vehicle (second/vehicle);

d_1 = uniform control delay assuming uniform arrivals (second/vehicle);

d_2 = incremental delay (second/vehicle);

d_3= Initial delay (second/vehicle);

PF= uniform delay progression adjustment factor, which accounts for effects of signal progression.

Good signal progression will result in a high proportion of vehicles arriving on the green. Poor signal progression will result in a low proportion of vehicles arriving on the green. The progression adjustment factor, PF, applies to all coordinated lane groups, including both pretimed control and non actuated lane groups in semi actuated control systems. In circumstances where coordinated control is explicitly provided for actuated lane groups, PF may also be applied to these lane groups. Progression primarily affects uniform delay, and for this reason, the adjustment is applied only to d_1. The value of PF may be determined using this following equation.

$$PF = \frac{(1-P)f_{PA}}{\left(1-\frac{g}{c}\right)}$$

Where;

P= proportion of vehicles arriving on green,

g/c= proportion of green time available, and

f_{PA}= supplemental adjustment factor for platoon arriving during green; and uniform delay can be calculated by using this equation,

IJIRSET

ISSN (Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization, Volume3, Special Issue 6, February 2014

National Conference on Emerging Technology and Applied Sciences-2014 (NCETAS 2014)

On 15th to 16th February, Organized by

Modern Institute of Engineering and Technology, Bandel, Hooghly 712123, West Bengal, India.

$$d_1 = \frac{0.5c\{1-(\frac{g}{c})^2\}}{[1-\{\min(1,x)\frac{g}{c}\}]} \tag{5.5}$$

Where;
c= cycle length (second); cycle length used in pretimed signal control, or average cycle length for actuated control,
g = effective green time for lane group (second); green time used in pretimed signal control, or average lane group effective green time for actuated control and X = v/c ratio or degree of saturation for lane group.
The incremental delay can be calculated by this equation.

$$d_2=900T\left[(X-1)+\sqrt{(X-1)^2+\frac{8kIX}{CT}}\right]$$

Where,
T=duration of analysis period (hour),
k = incremental delay factor that is dependent on controller settings;
I= upstream filtering/metering adjustment factor;
C = lane group capacity (vehicle/hour); and
X = lane group v/c ratio or degree of saturation.

III.RESULT

The average control delays from the four legged signalized intersections at Kolkata are presented in Tables 1, 2 respectively. The tables illustrate the initial delay, uniform delay, incremental delay and progression factor, incremental delay factor. These data was collected in peak time. Summarized result is given in table 1 and two.

TABLE1.
CALCULATED AVERAGE CONTROL DELAY AT DIFFERENT APPROACH OF ASUTOSH MUKHERJEE ROAD AND ELGIN ROAD CROSSING AT KOLKATA.

Sl.No	**Name of Approach**	**v/c Ratio**	**g/c Ratio**	**Uniform delay(d_1)**	**Progression factor(p)**	**Calculated Term (K)**	**Incremental Delay(d_2)**	**Average control Delay(d)**
1	Chowringhee Road (N)	1.01	0.471	18.55	0.93	0.56	38.01	55.18
2	Asutosh Mukherjee Road (S)	0.74	0.371	22.01	1.00	0.50	7.64	29.66
3	Elgin Road (E)	0.76	0.520	16.80	1.00	0.52	2.75	19.55
4	Shambhunath Pandit Street (W)	0.56	0.50	16.50	1.00	0.5	2.74	1924

TABLE2.
CALCULATED AVERAGE CONTROL DELAY AT DIFFERENT APPROACH OF HARISH MUKHERJEE ROAD AND SHAMBHUNATH PANDIT STREET CROSSING AT KOLKATA

Sl. No	Name of Approach	v/c Ratio	g/c Ratio	Uniform delay(d_1)	Progression factor(p)	Calculated Term (K)	Incremental Delay(d_2)	Average control Delay(d)
1	Harish Mukherjee Road (N)	1.02	0.37	22.11	0.83	0.5	35.01	53.37
2	Harish Mukherjee Road (S)	0.64	0.37	11.13	1.11	0.5	8.65	20.99
3	Shambhunath Pandit Street (E)	0.56	0.51	11.62	1.00	0.5	3.73	15.39
4	Shambhunath Pandit street (W)	0.79	0.51	20.03	1.20	0.5	8.80	32.84

IV.CONCLUSION

Three main conclusions were drawn from the study. The first was that the average control delay at signalized intersection, on a system wide basis, was higher equalize saturation flows rather than to minimize total intersection delay. This difference, as indicated overall increase in total delay was due to the small increases in delay experienced traffic volume periods. The overall increase in control delay was due to the small increases in delay experienced on the major street approaches especially during the peak traffic volume periods.

The second conclusion was that the control delay can be minimizing to redesign the signaling system as per change the traffic volume in different approach. If the driver travels the vehicles in design speed, the delay may be minimized. The third conclusion was that maximum control delay is occurred in north approach of the section in both crossing. Because the delay is varied with varying the traffic volume, low traffic volume reducing the delay with compare the higher traffic volume.

ACKNOWLEDGEMENT

We would like to express our gratitude and respect to Prof. Sandip Chakraborty of Civil Engineering Department, Bengal Engineering & Science University, Shibpur, Howrah; for his resourceful guidance, valuable advice, and constant encouragement without which it would not possible to give this paper within time.

We would also like to extend our gratitude and respect to Prof Sudip Kumar Roy, Prof Tapas Kumar Roy, Prof. P.K.Roy and other Professors of Civil Engineering Department, Bengal Engineering & Science University, Shibpur, Howrah for their help, valuable advice and constant encouragement.

We would also take the opportunity to express our grateful thanks to all our friends, and all of the faculty members of the Department of Civil Engineering, Modern Institute of Engineering & Technology, Bandel, Hooghly, who directly or indirectly helped our in completing this paper.

REFFERENCES

1. Hubbard, S.M.L., Bullock, D.M., and Mannering, F.L., “Right turns on Green and Pedestrian Level of Service : Statistical Assessment”, Journal of Transportation Engineering, ASCE, Vol. 135, No. 4, April 1, 2009.
2. Brian Wolshon and William C. Taylor, “Analysis of intersection delay under real-time adaptive signal control” Transportation Research Part C, Elsevier Science Ltd, Vol. 7, pp. 53-72, 1999.Moshe E.

IJIRSET

ISSN (Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

An ISO 3297: 2007 Certified Organization,   Volume3, Special Issue 6, February 2014

National Conference on Emerging Technology and Applied Sciences-2014 (NCETAS 2014)

On 15th to 16th February, Organized by

Modern Institute of Engineering and Technology, Bandel, Hooghly 712123, West Bengal, India.

3. Hsin-Yun Lee, "Optimizing schedule for improving the traffic impact of work zone on roads," Automation in Construction, Elsevier Science Ltd , Vol. 18, pp. 1034–1044, 2009.
4. Jan-Dirk Schmocker, "Multi-objective signal control of urban Junctions," – Framework and a London case study transportation research part C, Elsevier Science Ltd , Vol. 16, pp. 454–470, 2008.
5. Hai Yang and Sam Yagar, "Traffic assignment and signal control in saturated road networks", Transportation research paper –A, Vol.29A, Nov 2, PP.125-139, 1995.
6. Highway Capacity Manual-2000; Transportation Research Board.
7. Clarkson H.Oglesby and R.Gary Hicks, "Highway engineering", Prentice- Hall, Fourth edition.
8. Chakraborty Partha and Das Animesh, "Principles of transportation engineering", Prentice-Hall of India Private Limited, Third edition, October, 2007.
9. Papacostas C.S. and Prevedous, "Transportation Engineering & Planning", Pearson Prentice- Hall, Third Edition, 2008.

BIOGRAPHY

Name: Sukanta karati
B.Tech (Civil Engineering): Jalpaiguri Govt. Engineering College, Jalpaiguri
M.E (Civil Engineering): Bengal Engineering & Science University (BESU), Shibpur, Howrah Industrial Experience: Joined in a private company - Millenium Road Construction (MRC) at Burdwan (Head office Raygange) as an Assistant Engine. After half year I had resigned from this service. Present Status: Asst. Prof (Departmental Incharge), Modern institute of Engineering & Technology, Bandel, Hooghly