Synchronization of Signalized Intersection from Rasoma to High Court in Indore District

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Abstract- The control of traffic at highway intersections is of fundamental importance to traffic engineers engaged in finding ways to achieve efficient operation of only highway system. When traffic conditions warrant it, signalization may be considered an effective means of control at intersections since the number of conflict points at intersections could be significantly reduced with signalization. However, that an attempt to significantly reduce the number of conflict points will increase the number of phase required, which may result in increase delay. For signalized isolated intersections proper signal phasing and cycle time is very important to reduce the accidents, to allow safe crossing of traffic as well as pedestrian flow and reduce the overall delay. In the present work an attempt has been made to synchronize signal from Rasoma to High court via Patnipura in Indore district.

Index Terms- synchronize, cycle time, intersection,

I. INTRODUCTION

The signal synchronization program requires that travel time studies be conducted before and after the implementation of signal timing changes to determine how effective these changes have been. The purpose of a travel time study is to determine the average time it takes to traverse a corridor segment, street or highway facility. There are different methods to obtain travel time data. The travel time is obtained by adding the travel time corresponding to each run and dividing the result by the total number of runs.

In the near future, the implementation of intersection capacity, pedestrian and access management improvements (Sound Transit project) and signal timing optimization will result in even better traffic conditions in the corridor for all users including transit and pedestrians.

The importance of transportation in the development of country is multidimensional for example; one of the basic functions of transportation is to link residence with employment and producers of goods with their users. From a wider view point transportation facilities provide options for work, shopping and reaction, and give access to health, education and other amenities.

The increasing vehicular traffic on urban road network demands effective measures of traffic control on road-network, especially at the intersection, where turning movement and mixed traffic create congestion, traffic jam and chaotic scenes. Big cities like Indore face this problem in its acute form as the intercity and intercity traffic both have remarkable existence with mixed traffic conditions.

The provision of signal at the intersection is one of the methods to control the traffic at an intersection. For signalized isolated intersections proper signal phasing and cycle time are very important to reduce the accidents, to allow safe crossing of traffic as well as pedestrian flow and to reduce the overall delay.

For the design of signal cycle time and finding capacity of signalized intersection there are various method , these methods are useful and effective for homogeneous traffic like in western countries. But where mixed traffic is running on roads, as in India these methods cannot be effectively applied. As the presence of heterogeneous traffic and having no lane discipline, measurement of saturation flow and delay are also required special consideration in Indian conditions.

In the present study an attempt is made to find the lost time, saturation flow through video graphic technique. Then capacity analysis for the identified intersection has been done. Under the synchronized system, all the signals along a given street always display the same indication to the same traffic stream at the same time. As for as possible division of the cycle time is the same at all intersection a master controller is employed to keep the series of signals in step.

II. OBJECTIVES OF STUDY

The following are the objectives of the present study:

1) To design the signalized intersection at Patnipura chouraha in place of existing rotary
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2) To design the signalized intersection at Malwa mill chouraha.

3) To find optimum cycle time for intersection

4) Synchronize the signalized intersections from RASOMA (A. B. ROAD) to HIGH COURT via Patnipura.

III. METHODOLOGY

The following methodology has been adopted:

1) RECONNAISSANCE SURVEY: In order to work out details for the final survey to be carried out first a reconnaissance survey was carried out. The whole intersection area of Patnipura and Malwa Mill Chouraha was studied in detail. The traffic trend, traffic composition, Geometric features and other features like turning movements were keenly observed. The cycle time and Phase System of High Court and Starlit Intersection were keenly observed. The measurered distance from Rasoma, A.B Road to High Court Intersection are as follows:

1. Rasoma, A.B Road to Patnipura Chouraha	1.80 Km.
2. Patnipura Chouraha to Malwa Mill Chouraha	0.90 Km.
3. Malwa Mill Chouraha to Starlit Intersection	1.10 Km.
4. Starlit Intersection to High Court Intersection	0.45 Km.

2) GEOMETRY OF INTERSECTION: Malwa Mill Chouraha has five leg intersection and Patnipura Chouraha, Starlit Intersection; High Court Intersection has four legs. The detail physical measurements required for analysis are taken by direct measurement.

3) SIGNAL TIMING DETAIL: At present to control and regulate the traffic at intersection automatic pre-timed signals are provided at Starlit Intersection and High Court Intersection. Existing phasing system at all intersection are identified and green time, red time and cycle time are noted.

Signal Timings at High Court Intersection

Phase 1		**Phase 2**		**Phase 3**		**Total cycle time(sec)**
Green Time(sec)	Amber Time(sec)	Green Time(sec)	Amber Time(sec)	Green Time(sec)	Amber Time(sec)	
22	2	24	4	30	2	84

Signal Timings at Starlit Intersection

Phase 1		**Phase 2**		**Phase 3**		**Phase 4**		**Total cycle time(sec)**
Green Time (sec)	Amber Time (sec)	Green Time (sec)	Amber Time (sec)	Green Time (sec)	Amber Time (sec)	Green Time (sec)	Amber Time (sec)	
21	3	25	3	15	3	15	3	88

4) TRAFFIC SURVEY AT INTERSECTIONS: Measure the classified and directional traffic volume on each approach of Patnipura Chouraha and Malwa Mill Chouraha manually. For each approach traffic flow was recorded by manually for 3 hrs daily in evening with 15 minutes intervals.

IV. ANALYSIS AND SYNCHRONZATION OF SIGNALS

Having collected the data as mentioned in previous chapter, the acquired data have been put into detailed demand analysis for the estimation of saturation flow and design of signal timings. Following paragraphs present a detailed analysis and computational procedure for the present study.

1) ESTIMATION OF SATURATED FLOW: The method of measuring the saturation flow is described in a Road Research Laboratory publication. The following formula devised by Webster (1966), have been used to estimate the saturation flow.

$$S = 525 \times W \quad \text{PCU/Hr.}$$

Where,
S = saturation flow,
W = width of approach in meters
The above formula is valid for widths from 5.50 m to 18.0 m. for lesser widths the value may be obtained from following table.

Width (W) in meters	3.00	3.50	4.00	4.50	5.00	5.50
Saturation Flow (S)	1850	1890	1950	2250	2550	2900

When the approaches are in a gradient, the saturation flow needs some adjustment. Approximately this can be done by decreasing the saturation flow by 3 % for each 1% uphill gradient and increasing the saturation flow by 3 % for each 1 % of downhill gradient.

2) DETERMINATION OF OPTIMUM CYCLE TIME:
The optimum cycle time for minimum delay can be determined by using the below relationship given by Webster.

$$Co = 1.5\ L + 5.0 / [1 - (Y1 + Y2 + \text{---------} Yn)]$$

Where,
Co = optimum cycle time in sec,
L = total lost time per cycle in sec,
Yi = observed volume/Saturation flow ratio for critical lane group in each phase,
n =no of phases.
For Evening Peak Hours

3) DETERMINATION OF YELLOW TIME
Yellow period for each phase can be estimated by using below equation.

$$A = t + Vs/2a + (WI + 1)/Vs$$

Where,
A = Yellow Period in Sec
t = Perception Reaction Time = 1.0 Sec.
Vs = 85^{th} percentile speed of clearing vehicle in m/sec.
WI = intersection width in meters
l = length of standard vehicle = 6.0 m

4) DISTRIBUTION OF GREEN TIME TO EACH PHASE
Green time for each phase may be determined from equation.

$$Gi = [(qi/Si) / \Sigma(qi/Si)]\ c - A$$

Where,
(qi/Si) = Ratio of flow to Saturation flow for ith lane
c = total cycle time in sec.

V. SYNCRONIZATION OF SIGNALISED INTERSECTIONS FROM AB ROAD, RASOMA TO HIGH COURT VIA MALWA MILL

				Assumed Speed for Synchronization = 30 Kmph.				
S.No	**Movement**	**Speed in m/sec**	**Distance in Mts.**	**Vehicle Acceleration Time in Sec**	**Movement Time in Sec**	**Any other time in Sec**	**Total Movement Time in Sec**	**Remarks**
1	2	3	4	5	6	7	8	9
1	High court intersection to Starlit intersection	8.33	440	7	52.82	0	59.82	
						Say	60.00	
2	Starlit intersection to Malwa Mill intersection	8.33	1100	0	132.05	0	132.05	
						Say	132.00	
3	Malwa Mill intersection to Patnipura intersection	8.33	900	0	108.04	8.00	116.04	Speed is reduced due to less road width
						Say	116.00	
4	Patnipura intersection to Rasoma intersection	8.33	1800	0	216.09	0.00	216.09	
						Say	216.00	

Total time required to High Court to Rasoma = 524.00 Sec
Total Distance from High Court to Rasoma = 4240.00 Mts.
Therefor average speed of movement = 8.09 m/sec i.e.,
=29.13 Kmph

VI. CONCLUSION & FUTURE SCOPE

The following are the conclusions drawn from the present study:

1) 4 – Phase signalized intersection is designed for Patnipura intersection and obtained Optimum Cycle Time is 58 sec.

2) 5 – Phase signalized intersection is designed for Malwa Mill intersection and obtained Optimum Cycle Time is 66 sec.

3) An attempt is made to synchronize the signalized intersection between AB Road, Rasoma to High Court intersection for speed of 30 Kmph. with -out disturbing the cycle times of High Court intersections.

4) For synchronization the cycle times of Starlit intersection is reduce by 4 sec i.e. proposed cycle time of Starlit intersection become 84 sec in place of 88 sec. The movement in phase – 3 at Starlit intersection is observed less as compared to time provided for it, hence reduction of 4 sec is proposed in phase – 3.

5) For synchronization, the phase system of Starlit intersection must start 60 sec later than phase system of High Court intersection, the phase system of Malwa Mill Intersection must start 66 sec later than phase system of Starlit intersection and the phase system of Patnipura Intersection must start 58 sec later than phase system of Malwa Mill intersection.

The following points can be taken note for future work:

1) Synchronization of signalized intersections can be done with modification in cycle time for different speeds.
2) Synchronization can be done for other important streets of Indore city.

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