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Vehicular Delay at Pedestrian Crossing Due to Non-Synchronized Pedestrian Signal

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Abstract - *There are many factors for the delay of the vehicle on the road, some of these are controllable and some cannot be controlled. Fixed time pedestrian crossing signals can be controlled to reduce the vehicular delay on the stretch. This study is focused on the synchronization of the signal at the pedestrian crossing and nearest signalized intersection at sector 10-16 of the Chandigarh city. Unnecessary red time faced by the vehicles at the pedestrian crossing during the green phase of the intersection is considered as the delay time for the vehicles. Average 45% of the green phase for the vehicles was found delayed due to this pedestrian crossing.*

Key Words: Vehicular delay, pedestrian crossing, signal synchronization, pelican, Intersection, Rule violation, arrival rate.

1. INTRODUCTION

Chandigarh is a beautiful city in India which is one of the earliest developed cities after the independence of India. Chandigarh is famous for its urban design, but the current conditions of the traffic are making it difficult to handle such huge traffic and causing a lot of delays for vehicles in the peak hours. Due to this heavy vehicular traffic, a pedestrian crossing on the major arterial roads became more vulnerable to accidents. Roads in Chandigarh are divided as per the V7 concept of Le-Corbusier, who gave the design for this city (Chandigarh master plan).

Currently, in Chandigarh, traffic management is a major issue due to the congestion problems in peak hours and there has been seen a tremendous increase in the volume of the traffic in past few years (Bansal and Sandhu 2015). According to the Chandigarh police data, there is an increase of 100 vehicles per day in the city, currently, about 96% of the Chandigarh population acquire the vehicles which can be concerned with the traffic congestion in the city.

Vehicular delay is a major problem and results in many problems in case of emergency conditions, and if roads are not able to fulfill the needs of the users, it means that the roads are not updated as per the requirement (Zheng et al 2016). The problems raised due to the delay caused by the improper signals including socioeconomic and environmental pollution can be mitigated by the proper arrangement and synchronization of the signals. In a synchronized signal scenario, if the vehicle is moving with a specific speed, it can reach its destination without stopping at the signal because it will face only the green signal in the journey (Shambhavi and Pruthvi 2018)

2. METHODOLOGY

The main content of this study is divided into four sections. 3rd section includes site selection which shows the importance and necessity of the reason for the selection of site, 4th section includes data collection and experimental analysis which shows the synchronization of the signal timing of the pelican crossing and intersection signal, and 5th section consists of the conclusion part of the study.

3. SITE SELECTION

Chandigarh consist of major arterial roads which serves the major institute and commercial area of the city, Madhya Marg is one of the V2 roads of the city which serves important route of the city to connect with major hospitals like PGI and civil hospitals and other educational institutes. Madhya Marg is one of the busiest roads in the city. This road is selected for the study because only this stretch has installed a pelican on it in between the Matka chowk and junction number 18 chowk.

Fig -1: Satellite view of the site selected for the study

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Considering the movement of the traffic towards sector 15-11 as route no. 1 and towards the sector 9-17 as route no. 2.

4. EXPERIMENTAL ANALYSIS

4.1 Delay for vehicles on route no. 1

When this pelican signal is in the fixed-time mode it has a cycle length of 80 sec. but the nearest intersection has a cycle length of 108 sec. which makes an additional stop for some vehicles. To understand the concept, the chronology is described below:

Table -1: Signal timings at the pelican crossing and route no. 1

Particular	Pelican		Intersection		
	Green time (s)	Red time (s)	Green time (s)	Red time (s)	Amber time (s)
Time	47	33	54	50	4

Considering green and amber together, there are two timings (green + amber and red) for the intersection given below. Based on this timing chronology between the intersection and pelican crossing, the pelican crossing signal will repeat its timings after every 20 cycles of the intersection (36 minutes) as given in the table below:

Table -2: Synchronization of the signal timings of the pelican crossing and route no. 1

Sr. No.	Intersection signal alternate green and red	Pelican timing in relation to the intersection signal timing		
1	58	47	11	
2	50	22	28	
3	58	19	33	6
4	50	41	9	
5	58	24	34	
6	50	13	33	4
7	58	43	15	
8	50	18	32	
9	58	15	33	10
10	50	37	13	
11	58	20	38	
12	50	9	33	8
13	58	39	19	
14	50	14	36	
15	58	11	33	14
16	50	33	17	
17	58	16	42	
18	50	5	33	12
19	58	35	23	
20	50	10	40	
21	58	7	33	18
22	50	29	21	
23	58	12	46	
24	50	1	33	16
25	58	31	27	
26	50	6	44	
27	58	3	33	22
28	50	25	25	
29	58	8	47	3
30	50	30	20	
31	58	27	31	
32	50	2	47	1
33	58	32	26	
34	50	21	29	
35	58	4	47	7
36	50	26	24	
37	58	23	33	2
38	50	45	5	
39	58	28	30	
40	50	17	33	
41	58	47	11	

According to this scenario, the unnecessary delay faced by the vehicles is due to the red signal for vehicles at pelican crossing when it is the green phase at the intersection.

For these 20 cycles of the intersection, there is a total 478 sec (about 8 min.) unnecessary red for the vehicles. In these 20 cycles, there is an effective green of 18 min., out of which about 8 min. is taken by the pelican signal and it remains only 10 min green for the vehicles in these 36 minutes.

An average additional delay for the vehicles due to the pelican crossing is 24 sec per vehicle per cycle of the intersection.

This route is very important as it is a way for emergency vehicles (ambulance) towards PGI and also connect the educational institutes like PU and PEC.

4.2 Delay for vehicles on route no. 2

Vehicles heading towards sector 9-17 are already facing a red signal at the intersection and just after 150 m of distance, the pelican signal is installed, which causes an additional red for those vehicles. This is due to the different cycle lengths of the intersection and pelican crossing.

Table -3: Properties signal timings of the pelican crossing and route no. 2

Particular	Pelican		Intersection		
	Green time (s)	Red time (s)	Green time (s)	Red time (s)	Amber time (s)
Time	47	33	34	70	4

To understand the scenario of the delay synchronization between intersection and pelican crossing, the following table is created.

Table -4: Synchronization of the signal timings of the pelican crossing and route no. 2

Sr. No.	Intersection signal alternate green and red	Pelican timing in relation to the intersection signal timing		
1	38	38		
2	70	9	33	28
3	38	19	19	
4	70	14	47	9
5	38	24	14	
6	70	33	33	4
7	38	38		
8	70	5	33	32
9	38	15	23	
10	70	10	47	13
11	38	20	18	
12	70	29	33	8
13	38	38		
14	70	1	33	36
15	38	11	27	
16	70	6	47	17
17	38	16	22	
18	70	25	33	12
19	38	35	3	
20	70	30	40	
21	38	7	31	
22	70	2	47	21
23	38	12	26	
24	70	21	33	16
25	38	31	7	
26	70	26	44	
27	38	3	33	2
28	70	45	25	
29	38	8	30	
30	70	17	33	20
31	38	27	11	
32	70	22	47	1
33	38	32	6	
34	70	41	29	
35	38	4	34	
36	70	13	33	24
37	38	23	15	
38	70	18	47	5
39	38	28	10	
40	70	37	33	
41	38	38		

According to this scenario, the same signal relation is followed after every 20 cycles and total green at the intersection during these 20 cycles is 680 sec out of which 297-sec red is faced by the vehicles at the pelican crossing during the green phase at the intersection. Which shows a delay of average 15 seconds in each cycle of the intersection at the pelican crossing.

5. CONCLUSION AND FUTURE SCOPE

- The average delay for route no. 1 was found as 24 sec per cycle which is about 45% of the total green time of the intersection per cycle.
- The average delay for route no. 2 was found as 15 sec per cycle which is about 4% of the total green time of the intersection per cycle.
- These delays can be easily dissipated using synchronized signal timings for the intersection and the pedestrian crossing.
- For future work on the topic, the delay for the vehicles can also be calculated using shockwave analysis to consider the exact time loss due to the queue formation. In addition to that, the delay for the vehicles due to the rule violation of the pedestrians can also be found out.
- IRC 103 guidelines are used for setting a pedestrian crossing, these guidelines were last calibrated in 1988, these guidelines need an update for a better selection of the pedestrian crossing as per the prevailing conditions of the roads.

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