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Study of Traffic Flow in an Entire Day at a Congested Intersection of Chandigarh

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Abstract—*The increasing number of vehicles on our road intersections has given rise to the problems like road accidents, congestions, conflicts and bottlenecks. These problems can now only be solved by providing an efficient traffic control at intersections and that can be achieved by provision of a traffic signal system at intersections for continuous and efficient movement of vehicles through the intersections*
Chandigarh – the city beautiful – though a modern and well planned city, is also facing the same traffic problems. Here, the present traffic signals are based on the static feed of time without considering the actual available traffic. This leads to a situation where vehicles wait unnecessarily in one of the lanes while the traffic flow is not up to the considerable amount in the other lane. This paper provides the redesigning the existing traffic signals with a new cycle time by conducting an entire day traffic volume studies at the intersection.
The traffic field studies were done on the one of the congested intersection of Madhya Marg i.e. Transport Chowk for having the traffic data inputs.

Keywords*: Traffic Control, Inductive loop Detector, PCU.*

1. INTRODUCTION

Road intersections are critical element of a road section. Generally, in case of heavy traffic they turns out to be an obstruction to the continuous flow of traffic. So, as intersections arean important part of road network, these should be designed on the aim of decreasing the waiting time, conflicts and queues of traffic. Uniformity and simplicity, minimization of conflict points, safety, alignment and profile are four principles features of intersection design. It has been observed that many intersections in Chandigarh have become inadequate to handle the present day traffic causing congestion[1], delays and accidents particularly during the peak hours as the traffic control system installed on these intersections have become outdated due to the substantial increase in the traffic in recent years..

This problem can now only be solved by providing an efficient traffic control at intersections. The primary purpose of traffic signals is to separate conflicting traffic by the division of time, within the available road space, in a safe, efficient and equitable manner. Conflict at an intersection is manifested as an increase in delay and/or accident rate. The successful traffic signal system will impose the minimum delay on all traffic, consistent with safety. In addition, traffic signal improvements rank as one of the most cost-effective energy conservation strategies in urban areas. An idling engine not only wastes fuel, but also emits pollutants into the air. Therefore, the successful traffic signal system will also minimize fuel consumption and pollution in a neighborhood.

Traffic congestion is a severe problem in many major cities across the world and Chandigarh is one of them. Conventional traffic light system is based on fixed time concept allotted to each side of the junction which cannot be varied as per varying traffic density. Junction timings allotted are fixed. Sometimes higher traffic density at one side of the junction demands longer green time as compared to standard allotted time that's redesigning or adjusting the cycle time or green time comes into the play.

Madhya Marg is one of the most important roads in Chandigarh as it connects P.G.I. to Panchkula[2]. It also provides access to many educational institutes, shopping centers, restaurants, corporate offices, grain market etc. It is also the main route for the traffic moving towards Shimla & Kalka. So due to the above reasons, it has become necessary to consider it for the research works related to provision of providing efficient traffic control devices on it to reduce the congestion and travel time for the vehicles moving on this road.

Along the Madhya Marg, starting from Press Chowk (Sector 8) there are 8 intersections up to Housing Board Chowk among them 5 have been converted into signalized intersections and 3 are converted into rotaries. The signalized intersections are based on fixed time traffic signal system. In this paper, existing traffic conditions at one of the major intersections of Madhya Marg i.e. Transport Chowk are to be examined and traffic volumes and speeds data is to be taken accordingly. The signal timings will be designed on the basis of Webster's/ IRC method.

2. OBJECTIVES

The main objective is to minimize cumulative waiting time of vehicles on Madhya Marg by redesigning the existing traffic signals. The signal timing are to be changed according to the demand of present traffic on the intersection.

3. INSTRUMENTS AND METHODS

Instruments used

1. Sony Handy Cam
2. Smartphones
3. Power Bank
4. Radar Gun

Methods Used

1. Traffic Volume Study
2. Traffic Speed Studies

A video of the traffic at transport Chowk was recorded for the duration of continuous 12 hours i.e. 8:00 AM to 8:00 PM in order to have the entire day traffic data and also to identify the peak and off peak hours for the traffic flow.

Traffic speed studies were done on the each approach lane of the junction by use of Radar gun by taking 50 -100 observations in the input data.

4. RESULTS AND ANALYSIS

(A) Traffic Volume Study

The recorded 12 hour video is analysed by counting the number of different classes of vehicles by video playback in slower speed in VLC media Player in Computer. 12 hour video period was further divided into 3 intervals[9]:

8:00AM -12:00 PM: Morning time

12:00 PM – 4:00 PM: Afternoon time

4:00 PM – 8:00 PM: Evening time

The counted vehicles are then converted into passenger car unit by making use the factors given in table 1.

Table 1: PCU Factors [3]

Vehicle	PCU Factor
Car	1
2W	0.5
3W	1
Bus/Truck	3
Cycle	0.5
Rickshaw	1.5
LCV	1.5
Horse Drawn	4
Tractors	4.5

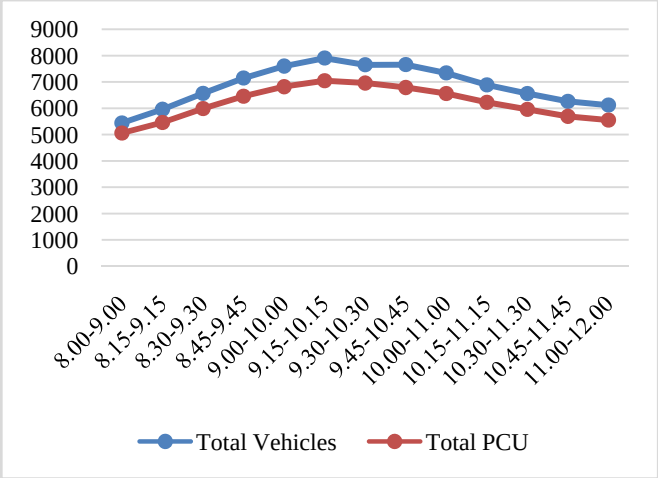

Fig. 1 Morning Time Traffic Flow

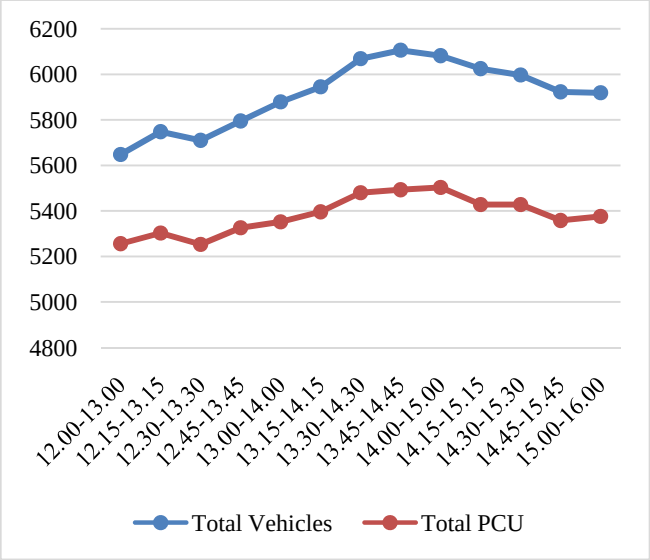

Fig. 2 Afternoon Time Traffic Flow

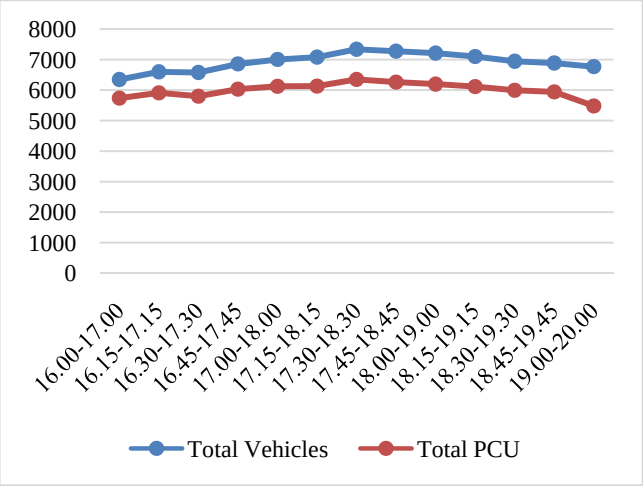

Fig. 3 Evening Time Traffic Flow

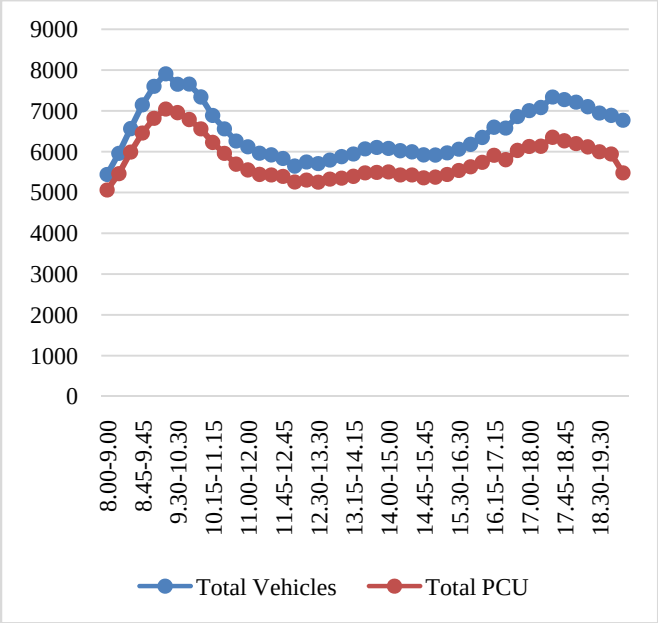

Fig. 4: Traffic Flow during Entire Day

After analyzing the video i.e. in 15 minute interval the peak hour traffic flow for the entire day and different periods of the day was identified and signals were redesigned for these peak hour flows.

During the entire day peak hour was recorded in morning period between 9:15 AM -10:!5 AM with 7046 PCU/hr. as far as the other periods are concerned morning peak hour was same as entire day, afternoon peak hour was recorded between 2:00 PM – 3:00 PM with 5503 PCU/hr and evening peak hour was recorded between 5:30 PM – 6:30 PM with 6354 PCU/hr. The signals were designed for these peak hours[7].

(B) Traffic Speed Studies

The traffic speed studies was done on the each approach lane of the intersection by making use of the radar gun. The 100 number of observations were taken for the 3 approach lanes and 50 number of observations were taken for the one lane as it has very less traffic and the time to complete the study is limited to 1 hours during off peak hour to obtain the speed under traffic free flow[8].

By analyzing the recorded data the 98th percentile and 85th percentile speeds were or found out by plotting the graphs between cumulative percentage frequency of vehicles and speed[6].

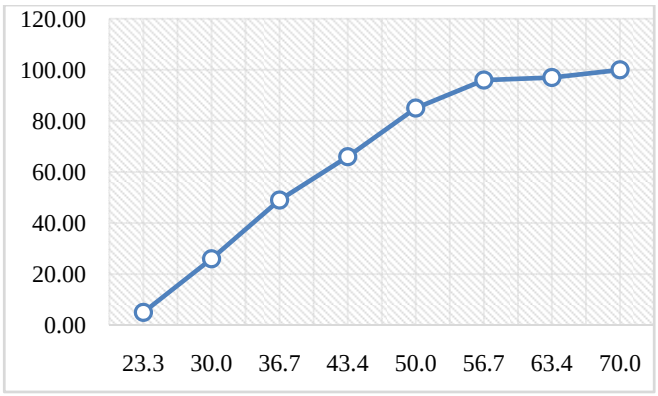

FIG. 5 Spot speed Graph for lane 1

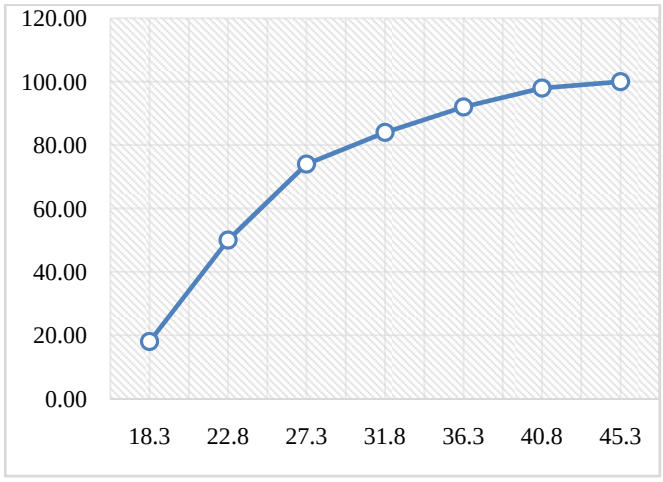

Fig. 6: Spot speed Graph for lane 2

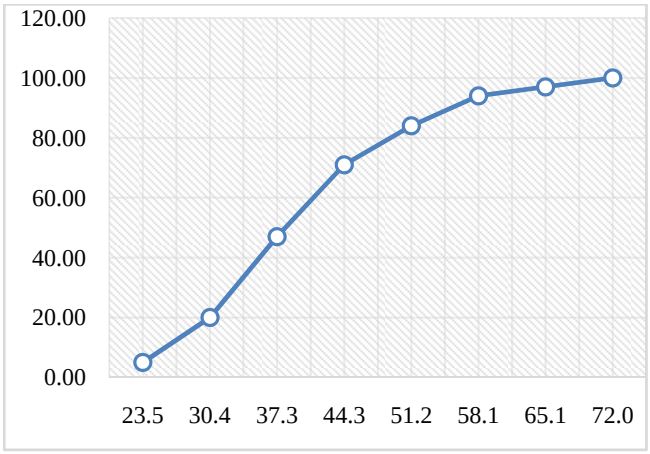

Fig. 7: Spot speed Graph for lane 3

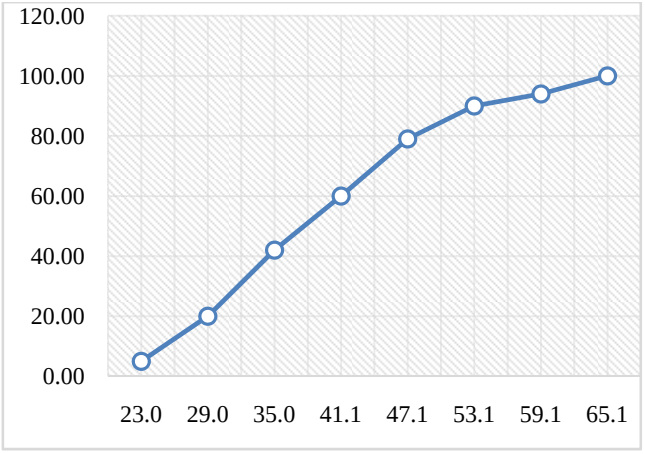

Fig. 6: Spot speed Graph for lane 4

Table 2 shows the 98th and 85th percentile speeds for each approach lane.

Table 2: Percentile Speeds

Approach Lane	85th percentile Speed (kmph)	98th percentile Speed (kmph)
Lane 1	50	66
Lane 2	32	41
Lane 3	52	67
Lane 4	50	63

(C) Traffic Signal design

A four phase signal system was designed for the intersection by making use of Webster's method for signal design and IRC method for the minimum time for pedestrian crossing[4].

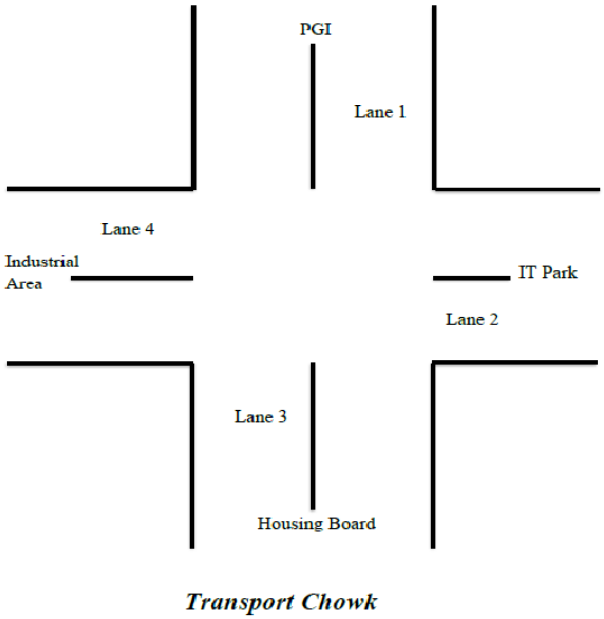

Fig. 7: Study Area

As the slip roads are already been provided at the intersection left turns are not included in the signal design and only right turning movements and straight traffic is included.

The Transport Chowk is shown in FIG. 7 and four phases taken into design consideration are:

Phase 1: Straight & Right movement for lane 1
Phase 2: Straight & Right movement for lane 3
Phase 3: Straight & Right movement for lane 4
Phase 4: Straight & Right movement for lane 2

Table 3: Designed Cycle Time & Green Times

Period	Cycle Time	Green time for 4- Phases			
		G1	G2	G3	G4
Morning	133	34	24	43	20
Afternoon	89	20	20	20	17
Evening	100	20	20	31	17

5. CONCLUSION

For solving the problem of congestion and waiting time on the intersections the signal timings should be changed accordingly with the present traffic demand. Since during the study it has been found that there are no area control systems are provided or installed in Chandigarh city for the control of traffic signals besides their control boxes on the intersection, so timings can only be changed from the intersection control box not remotely. The redesigned timings are much lesser as compared to the existing timings at the intersection, so if these are provided at these signals it will solve the problem of congestion and queue formation at transport chowk. As Lane 2 of transport chowk has less traffic flow a semi-automatic traffic control may be provided at the intersection which will include the installing of sensors on lane 2 such that the green time iss only allotted in case there is traffic flow at lane 2.

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