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DEVELOPMENT OF PASSENGER CAR UNITS (PCU), CASE STUDY OF GHANTAGHAR CHOWK, KARNAL DISTRICT OF HARYANA

[1]Er Sumit Rana,[2] Er Anil Kharb
M.tech Scholar GEC Panipat
Assistant Professor GEC Panipat
Email: [1]sumitrana2568@gmail.com,[2]anilsinghkharb@gmail.com

Abstract:-The increasing of traffic volume at our intersection has been arise a problems like road accidents, conflicts and congestions. These problems can solve by providing an efficient traffic signal control at the intersection for continuous and efficient movement of vehicles through the intersection. According to traffic signal, signal timing is most important which is used to decide green time of the traffic light shall be provided at an intersection and how long the pedestrian walk signal should be provided. Traffic volume studies are to be made to determine the number, movement and classification of vehicles at the given location. These data is used identify normal flow of the road; determine the influence of heavy vehicles or pedestrians on vehicular traffic volume. The length of the sampling period depends on the type of count being taken. 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. 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.

Keywords: Traffic Control, PCU, Automatic Traffic Control, Intersection, Traffic Field Studies.

1. INTRODUCTION

The problems of urban transportation are well known not just for traffic engineers but to people in all walks of life. Overcrowded and congested with vehicles of all type creating lots of traffic problems and pollutions making the cities a veritable jungle. The problem as exist today can hardly be delinked from its problem of town planning and its implementation. In fact bottlenecks in the urban transportation system have risen because the cities are not planned and built for supporting the volume of population they are given shelter today. Travel has become inherently risky activity in cities. Traffic consists on Indian roads of bi-directional freedom traffic such as two or three wheeled vehicles and uni-directional vehicles such as four wheelers or rejected by various modes of traffic. To prevent traffic accidents, conflicting traffic streams are separated either in space or in time.

2. LITERATURE SURVEY

Ankit N Mahidadiya et al (2016) reviewed the Global Scenario on Estimation of Passenger Car Unit. In India, traffic condition is mixed. It cannot be consider all vehicle type as same. As they have different interfere on road traffic. Passenger Car Equivalent (PCE) or Passenger car unit (PCU) is thus a metric used to assess traffic-flow rate on a highway. Passenger Car Unit (PCU) is the metric used to convert heterogenic traffic in to homogenous traffic. In India traffic pattern is heterogeneous, it is necessary to convert heterogeneous traffic to homogenous traffic while designing any signalized intersection. PCU Value is dynamic in Nature. PCU value is depends upon current road traffic condition. These PCU values (devised in developed countries) are not suitable for Indian heterogeneous traffic conditions this paper reviews the estimation carried out to find PCU value worldwide

B.Sudharshan Reddy et al (2016) designed the signal for T-intersection by using Webster's method in nandyal town, Kurnool district of Andhra Pradesh. Traffic volume studies are to be made to determine the number, movement and classification of vehicles at the given location. These data is used identify normal flow of the road; determine the influence of heavy vehicles or pedestrians on vehicular traffic volume. The length of the sampling period depends on the type of count being taken. 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. 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.

Ishant Sharma (2015) studied on the automatic traffic signal system for Chandigarh. 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 automated volume based traffic signal system at intersections for continuous and efficient movement of vehicles through the intersection 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 feasibility of replacing existing traffic signals with a system to monitor the traffic flow automatically in traffic signals where sensors are fixed in which the time feed is made dynamic and automatic by processing the live detections. The paper deals with the feasibility of provision of inductive loop detection based traffic signals in place of existing pretimed traffic signals by comparing their performance, suitability and economics. In present study, firstly, Traffic field studies is used to have the traffic volume and speed data of the Transport Chowk Intersection which are used as input for the redesign of pretimed traffic signals [8] by Webster's and IRC method and also for the design of automatic traffic signals. And from the study, It can be concluded that the by replacing the pretimed traffic signals with the automatic traffic signals, capacity is being increased and LOS is also being improved.

Suhas Vijay Patil et al (2015) studied the development of passenger car units (PCU). In this study an attempt is made to find out Passenger Car Unit (PCU) value for Nal Stop. Passenger Car Unit (PCU) value of each class of vehicle is very important for any mixed traffic flow studies. These may be concerning traffic flow parameters, capacity, signal design, parking lots etc. The work took into account the effect of mixing of traffic, speed and headway. A set of PCU values was then derived. The analysis is based on the field studies conducted at Nal Stop in Pune city considering almost all classes of vehicles commonly found in Pune city, India. The PCU value of each vehicle is not a constant but varies with several factors such as proportion of other classes, level of service, volume to capacity. The speeds of individual vehicles in the queue need not to be precisely equal, but may vary slightly from vehicle to vehicle and similarly the time headway of individual vehicles in the queue. In this study, the average value of speed and time headway is taken.

Veethika Gomasta et al (2015) designed the intersections for Improved Traffic Flow at Bhopal-Case Studies of Jyoti Talkies Square and Vallabh Bhawan Roundabout. In this paper the signal timings at "Jyoti talkies square" have been redesigned for afternoon peak flow. Improvement by widening of road is recommended. At the other intersection called "Vallabh Bhawan roundabout", capacity of rotary is calculated whether it is within its permissible limits or not. Introduction of Signalized rotary is suggested.

Sachin Jat et al (2015) designed the signal at intersection of vidisha to control the traffic. In this paper the traffic volume of intersections of the Vidisha city and traffic signals were designed at each intersection. The one part of the thesis is survey of traffic volume, which is done by manual method, wherein the vehicles are counted manually without using any device or sensor with respective vehicle categories like passenger, commercial and agricultural etc. and the other part is design of traffic signals, which is done according to the IRC method of signal design by adopting maximum PCU on the intersection in each direction. The design of traffic signals at these intersections in vidisha will help the growing traffic to move with ease and safety and also helps in reducing the accident rate at the intersections due to congestions and confliction between vehicles.

Chris Lee at al. (2015) has estimated PCE value for heavy vehicles at three four-leg roundabouts in Vermont, Ontario, Canada and Wisconsin using vehicle movement data collected from video cameras. The PCEs were determined such that the coefficient of variation in 1- min entry capacities is minimized. The study also applied the PCEs to the prediction of the entry capacity using the HCM 2010 roundabout capacity model. For the model inputs, the critical headway and the follow-up headway were adjusted based on the difference in driver's gap acceptance behavior between cars and heavy vehicles.

3. TRAFFIC STUDIES

Traffic studies or surveys are carried out to analyze the traffic Characteristics. These studies help in deciding the geometric design features and control for safe and efficient traffic movement. The various traffic studies generally carried out are:

1. Traffic study
2. Speed studies
3. Origin and destination study
4. Traffic flow characteristics
5. Traffic capacity study
6. Parking studies
7. Accident studies

4. TRAFFIC VOLUME STUDY

One of the fundamental measures of traffic on road system is the volume of traffic using the road in a given interval of time when the traffic is composed of a number of types of vehicles; it is the normal practice to convert the flow into equivalent P.C.U by using certain equivalency factor. The flow is expressed as PCU per hour.

METHODS FOR TRAFFIC COUNTS

1. Manual methods
2. Combination of manual & mechanical method
3. Automatic Method
4. Moving observer method
5. Photographic method
6.

5. DATA COLLECTION

In Karnal, Ghantaghar Chowk was selected to conduct the traffic study using the manual count method.

1. Speed measurement:

Speed of different classes of vehicle was measured using the speed gun software in a smart phone.
Classified traffic volume counts were also obtained by manual count method.

2. Time headway measurement:

Time headway of different classes of vehicles was measured. This was done by observing the time headway for a constant distance of same class of vehicle.

3. Width and lateral clearance:

On most of the roads, vehicles are travelling behind each other in more or less as a lane. Since this lane concept holds well, there will not be much change in the PCU value from this factor. Hence, the effective width and transverse clearance was not considered.

6. DATA ANYLYSIS

6.1SPEED DISTRIBUTION

The PCU factor is based on the mean speed values of different vehicle classes. This is calculated by dividing the mean speed value of passenger cars by the mean speed value of any vehicle class. The values are given in Table-6.1

Table 6.1: speed values in km/hr

Sr.No	2 W	3 W	4 W	Bus/Truck
1.	23.5	16.9	15.4	8.9
2.	18.9	18.4	14.2	12.6
3.	28.1	13.7	14.3	11.3
4.	21.6	17.3	12.5	11.8
5.	30.3	18.7	12.2	10.2
6.	19.8	15.4	9.4	10.2
7.	27.7	16.3	16.7	10.7
8.	22.3	17.8	18.3	8.6
9.	20.0	15.6	20.2	9.3
10.	22.9	19.8	18.3	12.7
Average	**23.51**	**17.00**	**15.15**	**10.63**

Fu= Uc/Uv

Where
Fu = PCU factor for speed of vehicle class V.
Uc = Mean speed of car.
Uv= Mean speed of the vehicle class V.

Sample Calculation:

For Motorcycle.
Fu = 0.7231

Table 6.2: PCU factor for speed

Class of Vehicle	Mean Speed Uvkmph	Speed Factor Fu=Uc/Uv
Two Wheeler	23.51	0.7231
Four Wheeler	17.00	1.00
Three Wheeler	15.15	1.2211
Bus/Truck	10.63	1.5992

6.2 WIDTH AND LATERAL CLEARANCE

In most of the roads considered, the traffic is following each other in a lane and there is not much of disturbance within the lane. Hence the factors like the average length and width of each vehicle class and the average transverse gap between vehicles has not been considered. The effect of this is assumed to be unity as the equivalent factor for width.

Fw= Wv/Wc

Where,

Fw= PCU factor for Lateral clearance for vehicle class V.

W_c= Transverse gap for cars.

W_v= Transverse gap for vehicle class V.

6.3 DETERMINATION OF PCU VALUES

As discussed, the PCU value of a vehicle a turban mid-block depends upon the:

a) Average effective width Wv.

b) The mean speed Uv.

c) Mean lower time headway tv.

With the increase in mean speed of vehicle the time spent by the vehicle decreases. Lesser the speed, greater is the hindrance to the other vehicles. When other factors remain constant, PCUv is inversely proportional to Uv.

Table 6.3: PCU values for Ghantaghar Chowk

Class of Vehicle	Width Factor	Speed Factor	Headway Factor	PCU Values
Car	1.00	1.00	1.00	1.00
Motor Cycle	1.00	0.7231	0.7292	0.5273
Wheeler	1.00	1.1221	1.1458	1.2857
Bus/Truck	1.00	1.5992	1.6042	2.5654

7. CONCLUSION

The analysis is based on the field studies conducted at Ghantaghar Chowk in Karnal city considering almost all classes of vehicles commonly found in Karnal city, India. The PCU value of each vehicle is not a constant but varies with several factors such as proportion of other classes, level of service, volume to capacity. The speeds of individual vehicles in the queue need not to be precisely equal, but may vary slightly from vehicle to vehicle and similarly the time headway of individual vehicles in the queue. In this study, the average value of speed and time headway is taken.

8. FURTHER SCOPE OF WORK

The data collected from traffic survey and after converting traffic into PCU, peak hour traffic flow can be determined and hence a solution to make traffic flow free can be designed. The PCU value is a function of space and time and PCU values replicated here are confined for a particular stretch of Ghantaghar Stop, Karnal. However extensive research is to be carried out for the denervation of precise PCU values. To continue with the further project work following macroscopic traffic parameters needs to be determined.

a) Traffic characteristics.

b) Traffic studies and analysis.

c) Traffic survey.

d) Field survey.

e) Origin and destination.

f) Traffic planning

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