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Study of Design Traffic Signal

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Abstract: *The increasing of traffic volume at our intersection has been arise a problems like road accidents, conflicts and congestions. These problems can now only be solved by providing an efficient traffic control at intersections and that can be achieved by provision of traffic signal system at intersections for continuous and efficient movement of vehicles through the intersections. 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. 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. In India PCU value is based on value given in IRC SP 41. Developed countries devised several methods for calculating PCUs. 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 research work the traffic signal for Agrasen chowk is designed by the various traffic surveys.*

I. INTRODUCTION

Transport is an all operable industry. It penetrate into all phase of production and distribution of goods. In the production stage, transportation is required for carrying raw material and in the distribution stages; transportation is required from farm and factories to the marketing centers for distribution to the retailers and consumers. Transportation improvement has increased personal mobility, reduce travel time, permit greater freedom to select the people their work and in the carrying of goods. However the unprecedented growth of vehicles ownership especially the small cars and scooters in recent years, our cities are beset with serious traffic problems like congestion and casualties particularly at road intersection due to land constraints. A multidisciplinary approach is needed in understanding the situation and providing the solutions. To solve the problem of congestion at intersections, coordination of traffic regulation is required and intersectional area may be expanded or grade separations may be adopted. In order to study and evaluate the congestion at urban intersections, it is important to acquire factual knowledge of traffic characteristics and to carryout studies and analyse the situation for relieving congestion thereby increasing the capacity of intersection. The spectacular growth in the number of vehicles on the road has created a major social problem- the loss of lives through road accidents. The traffic on roads in India is increasing at a very rapid pace due to industrial growth and socio-economic changes in the society. As a result of the steep growth of the motor vehicles, the traffic on the road has been increasing continuously. Automobiles have become an essential part of human society for both its day to day functioning and growth. This has resulted in the problem of congestion and casualties on the roads, particularly at road intersections. Urban roads should be designed to be safe and to permit the free flow of traffic at reasonable speed. Their traffic capacity should be balanced against the traffic requirement of the existing and proposed development. This will necessitate the planning of the urban road network as a whole and will involve forecasting future traffic volume and appropriate controls of parking, land development for increasing the capacities of rotaries and road intersections to ensure that the network will continue to function efficiently.

The solution to the problem of congestion requires coordination and optimization of traffic regulation measures and in many instances redesigning of the intersection to make it safe and to permit the free flow of traffic at required speed. India has experienced a tremendous increase in the total number of registered motor vehicles are shown in figure 1.1. The total number of registered motor vehicles increased from about 0.3 million as on 31st March, 1951 to about 230 million as on 31st March, 2016 and increased upto 250 million approximately in march, 2019 . The total registered vehicles in the country grew at a Compound Annual Growth Rate (CAGR) of 9.9% between 2001 and 2018.

II. LITERATURE REVIEW

In my dissertation entitiled “Study of Design Traffic Signal” Many previous works are done and studied by me some research Reviews are discussed below:-

Raghavendra S.Sanganaikar et al (2018) Studied that 16 people die and 58 are injured every hour in India due to road accidents – the death rate, in fact, is equivalent to wiping out about 40 percent of the population of a small nation like the Maldives in a year. 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. The worst accident hotspots are near flyovers and junctions without signals. The increasing of traffic volume at the intersection has been on the rise which has resulted in many problems like road accidents, conflicts, and congestions. The Design of traffic signal is done according to the Indian Road congress (IRC 93) method of signal design by adopting maximum average Passenger count unit (PCU) on the intersection in each direction. The first traffic signal was fixed in London in 1868 , which was a semaphore- arm type signal. In this paper, we have taken kundalahalli junction, which is surrounded by 2 shopping malls, restaurants, corporate offices, etc.

Sumit Mishra et al (2018) Design of Traffic signal, Traffic jams can be avoided by controlling traffic signals according to quickly building congestion with steep gradients on short temporal and small spatial scales. With the rising standards of computational technology, single-board computers, software packages, platforms, and APIs(Application Program Interfaces), it has become relatively easy for developers to create systems for controlling signals and informative systems. The system proposed is fail-safe against temporal communication failure. Along with a case study for examining congestion levels, generic information processing for the cycle time decision and status delivery system was tested and confirmed to be viable and quick for a restricted prototype model. The information required was delivered correctly over sustained trials, with an average time delay of 1.5 s and a maximum of 3s.

Amanpreet Guliani, Er. Neeraj Kumar (2018), According to the Road traffic in India is termed to be highly heterogeneous which comprises of different types of vehicles like bus, truck, auto-rickshaw, bike, scooter, cycle etc. comprising of wide range of static and dynamic characteristics. Hence, expressing traffic volume as number of vehicles for a specified section of road or traffic lanes per unit time those are available terms to be inappropriate for vehicles related to different types with its static and dynamic characteristics comprising in traffic, which generally varies for large extent. evolution of the road industry and growing traffic on roads, construction materials have also been evolved and more unconventional ingredients have been incorporated. The construction and maintenance of roads consume large amounts of quarried aggregates. The use of secondary (recycled), instead of primary (virgin), material helps in reducing demand of extraction. The inclusion of such materials entails several secondary and tertiary materials.

Hamant Gulati, Dr.Devinder Sharma, Er.Neeraj Kumar(2017) based on research India is a developing country and safety of roads is still in a premature stage. Accident severity is increasing due to increasing in vehicle population. The road accident situation in India is alarming. Records show that there is one death at every 4 minutes because of road accidents. Road Safety is necessary to reduce accident involving both human and vehicles there by making the road more safe and user friendly to traffic. Area selected for the study was the Ambala Chandigarh Expressway section (km 5.735 to km 39.960 on NH-22 and 0 km to 0.871 km on NH-21).

Ankit N Mahadiya 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.

Ishant Sharma (2015) Analyse 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. 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 by Webster’s and IRC method and also for the design of automatic traffic signals.

Chris Lee et al. (2015) Study of 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.

M. Mardani et al. (2015) Evaluated that PCU value (figure-4) for a vehicle type varies with traffic volume and composition on the road. It is also affected by the type of road as well. Carriageway width also affects the PCU value for all types of vehicles.

J. R. Juremalani et al. (2015) Reviewed on the PCU reveals that studies conducted are mostly related to fairly homogeneous traffic conditions, and the few studies conducted under heterogeneous traffic conditions are not comprehensive enough to replicate the field conditions accurately.

A. A. Obiri-Yeboah et al (2014) Employed the headway method for estimation of PCU for the traffic mix and flow conditions prevailing at signalized intersections within the Kumasi Metropolis, Ghana. Vehicles considered were placed in three categories; cars, medium vehicles and trucks. The PCEs developed from this study were 1.0, 1.65, and 3.05 for cars, medium vehicles and trucks, respectively, at intersections where roadside friction to flow existed. Where such friction did not exist, the values were 1.0, 1.35, and 2.25 for cars, medium vehicles, and trucks, respectively, which were much lower. The differences in PCE values for corresponding categories of vehicles in the two situations are believed to be a reflection of the impact of roadside friction to vehicular flow at the intersections, which appeared to be more severe on trucks than the other vehicle categories. PCE values which have been adopted from the Overseas Road Note 11 (17) are 1.00, 1.10, and 2.25 for cars, medium vehicles and trucks, respectively.

A. Mehar et al. (2014) has demonstrates the effect of congestion level (v/c ratio) on PCU of different type of vehicles on multilane interurban highways. Although the PCU values given are derived for Indian conditions, yet the methodology is quite general and can be used by other researchers to derive PCU values for traffic condition in their countries as well. The major objective of this research was to quantify the effect of traffic volume and composition on PCU values and authors have successfully demonstrated it.

Yahya R. Sarraj (2014) has analyzed the average PCE value for heavy trucks in Gaza. It was found to be 2.23, whereas it was 1.43 for medium trucks and 1.51 for animal-driven carts. In his paper the selection of the signalized intersections was based on the following criteria: High traffic volumes, significant queuing, no parking allowed at or close to the intersection and good mix of different vehicle types. Data was collected at three signalized intersections in Gaza city. Several methods may be used to collect data such as: manual method using a stop-watch, pressure-contact-strip method, sonic detectors and a digital video camera.

Vidhya & Banu (2014) designed a project to develop a density based dynamic traffic signal system. The project consisted processing of image captured in the traffic signal and then it was converted to grayscale image and after that to calculate the number of vehicles contours was drawn to have its threshold. Calculation of number of vehicles gave the density which was further used for allocating green time to the traffic on the approach lane by using the Raspberry pi as a microcontroller.

Rekha & Karthika (2013) presented a combination of inductive loop sensors and fuzzy logic technology in which inductive loop sensors were responsible for real-time traffic data and fuzzy logic technology was responsible for the allotment of green time to the traffic to clear off the intersection efficiently. This method was proved to be very effective in handling the traffic.

III. STUDY AREA OF AGRASEN CHOWK YAMUNANAGAR

The City of Yamunanagar, one of the premier cities of Haryana has been taken for the study. This City is known for its number of heavy industries like metal, plywood, Steel, sugarmill and number of educational institutes in different parts of city. In addition, Yamunanagar city also enjoy religious importance due to the presence of Kapal mochan and Adi badri. Yamuna Nagar is well known for its industries. It has emerged as an important industrial destination in the state. This has been despite its relatively isolated location from rest of the state. Due to expanding industries, the city kept on extending geographically. This is primarily due to an increasing number of immigrants. With increasing population, the trading aspects became brighter and the city went on becoming the second highest revenue generator of Haryana immediately after Faridabad that owes its position largely to its prime location. The city produces sugar machinery, paper machinery along with equipments for petrochemical plants which are shipped to various refineries across the country. The city is also known for its Plywood productions, which is attributed to the easy accessibility of primary raw material poplar tree. It has also one of India's largest railway carriage and wagon repair workshops Recently, Reliance Industries has also installed a thermal power plant in the town. Jagadhri, the other part of twin city is called as brass city and is famous for its brass and stainless steel utensils. The population of the city which was 3.61 lac in 2001 has increased to around 4.73 lac in 2011. With ever increasing population, the vehicle ownership is also increasing at very fast rate thus causing number of traffic problems. The number of vehicles registered in year 2005 was 15848 which further increased to 23500 in the year 2018.

IV. IMPORTANCE OF STUDY NATIONAL HIGHWAY-907 (AGRASEN CHOWK)

NH-907 is the main road of Yamunanagar. This road is considered to be important as it provide access to Bus stand, Railway station, Workshop, Industrial area and to residential colonies. Due to narrow road width and heavy traffic on the road, traffic problems on this road are increasing day by day.

The various traffic problems that are taking up are as follows:

- A. Inadequate parking space.
- B. Restriction to speed.
- C. Heavy congestion.
- D. Increase in number of accidents.
- E. Longer delay at intersection.

V. OBJECTIVE OF STUDY

The main objectives of the study are as follows:

- A. Traffic study of the intersection Agrasen Chowk for develop a traffic signal control.
- B. To quantify the traffic problems at study area and identify the necessary actions to improve those traffic problems.
- C. To conduct necessary traffic studies on the selected stretches of the road in order to know existing traffic conditions.
- D. To suggest some effective measures to prevent traffic problems on Road in future.
- E. To be used for the analysis of traffic patterns and trends.
- F. Planning pedestrian signal timing.
- G. Pedestrian volume study is used for planning pedestrian signal.

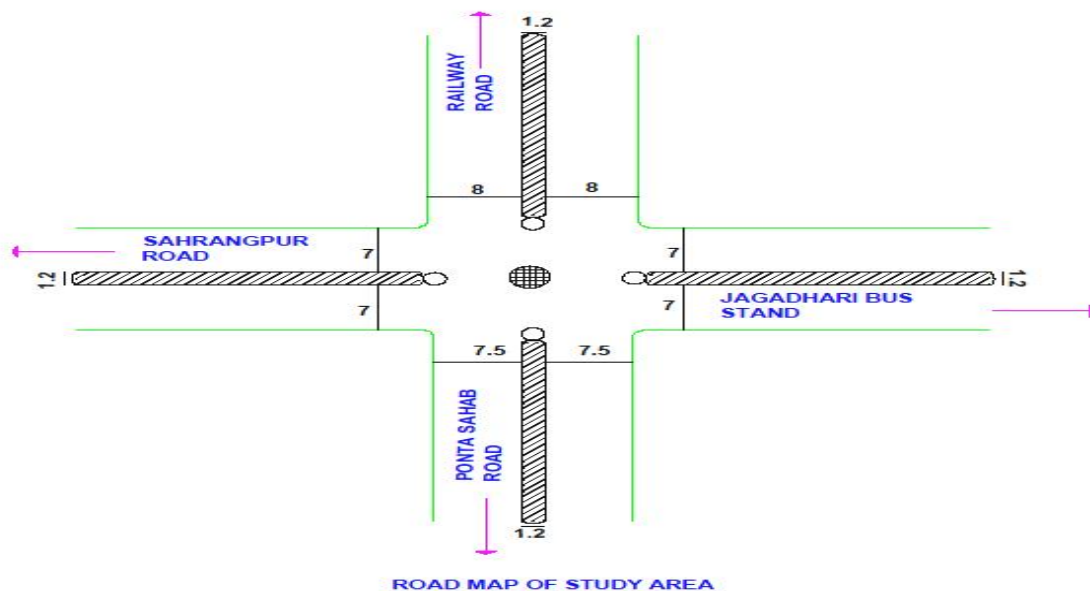


Figure: 1.3 Road Plan of Intersection at Site (NH-907)

VI. SCOPE OF STUDY

The scope of the study encompasses appreciation of identifying the road sections for conducting necessary traffic studies and to quantify problems with view to suggest improvement measures. The traffic studies include

- A. Traffic Volume Count Study at Agrasen Chowk Intersection, Yamunanagar
- B. Spot Speed Study on road approaching to the intersection
- C. Design of signal at Agrasen Chowk Intersection

These traffic studies would enable quantification of traffic flows, identification of causes for delay and inefficiency besides traffic accidents. Keeping in view the scene of the city with the existing traffic problems and as a part of continuing programme of reviewing and redesigning Intersections, the main object of this investigation is to critically study road intersections with reference to their traffic control measures traffic performance and other relevant features and thereafter redesign them according to the requirement of the present and future traffic and Suggest improvements in their present layout. The conclusions and recommendations from these studies will be helpful in better understanding of the problems and finding of the effective measures to overcome all those problems.

VII. CONCLUSIONS

- A. In urban area, signals are found to be more efficient and suitable than the roundabouts due to space restriction. But in rural areas, roundabouts may be used with great efficiency.
- B. Traffic is uneven on all the four legs approaching to the intersection. NH-907 carries higher traffic despite of lower lane width (7.0 + 7.0 m) as compared to cross road (Jagadhri/Saharanpur) (7.0 + 7.5 M).
- C. Busses and Auto Rickshaws coming from Jagadhri road side and turning towards Buria Chowk side stops at unscheduled places during peak hours near the intersection leading to traffic congestion.
- D. Traffic from Railway Station side and Jagadhri road side possesses slow speed (15.33 and 15.48 Km/h respectively), leading to congestion.
- E. The rational method to design the signal timing scheme is only Webster's method. It gives least delay and optimum cycle time; therefore, Webster's method should be used for designing signal scheme.
- F. The main contribution factor to the lock up at intersection is the heavy traffic volume during morning and evening peak hours, which was not considered at the time of existing design of the intersection.
- G. Due to heavy traffic, during peak hour and higher percentage of right turning traffic, lockup occurs at intersection. The present peak volume at the intersection examined in the report is 4655 PCU/hr with 34.76% right turning traffic.

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