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Study of Traffic Flow at a Three Legged Busy Intersection in Vellore, India

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Abstract. The rapid growth in economy has resulted in an intense increase of personal vehicle usage which resulted in road traffic congestion in all metropolitan cities like Chennai, Bengaluru, etc. As Vellore has a good transportation network, it experienced a substantial urban growth especially after it becomes a city corporation in 2008. One of the ill or side effects of urbanization is traffic bottlenecks and before suggesting remedies to address the traffic problems, understanding the current situation is very important. Analysis of traffic flows or volumes at busy intersections in order to find the mode share percentage, directional distribution and peak period traffic volume is the first and foremost step to understand the present situation of traffic. Hence in the present study, a busy intersection in Vellore called Chittor bus stand intersection near VIT was selected and volume data was collected through video surveys. The collected flow or volume data was carefully examined to identify the modal share, directional distribution and morning & evening peak hour traffic volume. The results showed that the two wheelers and three wheelers comprise 82% of the total volume and the proportion of cars is only 11%. The traffic data analysis showed that the light commercial vehicles (LCV) and heavy motorized vehicles (HMV) constitute 7% of the total traffic. A highest hourly volume of 7573 PCU's was observed between 9.30 am and 10.30 am during morning and 7336 PCU's between 5.40 pm and 6.40 pm in evening. By taking a 10% growth in traffic every year, then in the year 2021, the traffic volume at the intersection may reach 10,000 PCU's and may warrant for a flyover or grade separator at the intersection.

1. Introduction

Migration of people to urban centres due to economy growth in India has resulted in traffic problems in almost all the cities in our country. People who live in cities are expected to increase from 3500 million in the year 2010 to 6300 million in 2050 [1]. This twofold increase will lead to many problems in all the major cities of the world and similar situation exists in India too. Tamil Nadu stands next to Gujarat and Maharashtra as 50% of the state population are living in cities. The major reason for traffic congestion in cities is the lesser use of public transportation and increase in usage of personal vehicles such as cars and two-wheelers. In Chennai alone, private or personal vehicles have experienced a significant increase from 1 million in 1999 to 4.2 million in 2017. Similar to Chennai, other cities in Tamil Nadu like Trichy, Salem, Madurai, Coimbatore, Vellore, etc. were experiencing considerable urbanization in recent years which resulted in personal vehicular growth. As Vellore is located close to the capital city of Chennai and good transportation network, it experienced a substantial urban growth. For any city, it is essential to have a circular ring road or bypass road around the city in order to separate the bypassable traffic from city traffic. However in Vellore, still now there is no such ring or circular road which can connect the important national highways that passes through

the Vellore city. Hence all trucks and trailers are using the roads which are within the city limits and hence create traffic congestion during peak hours in one of the arterial road in Vellore, namely, Vellore – Katpadi road.

In order to address the traffic congestion problem in Vellore – Katpadi road, it is very essential to first understand the present context, i.e., first we need to study the traffic volumes at intersections along the route to get an idea of modal share of different vehicles, peak hour traffic volume and direction-wise distribution. This traffic volume study also will help us to check whether a traffic signal or a flyover (grade separator) is required at the intersection. Lal et al. [2] collected the traffic and pedestrian data at one of the busy intersections in Ettumanoor in Kottayam, Kerala and proposed various traffic improvement plans/measures to increase the vehicular flow at the junction. Errampalli and Kayitha [3] conducted traffic volume studies at busy intersections and proposed traffic management plan for the city of Port Blair in India. Many such studies were carried out in India and abroad. In the present work, one of the important intersections in Vellore – Katpadi road, namely Chittor bus stand intersection near VIT was took and traffic volume data was collected through videographic surveys. The collected video data was analyzed to get the modal share of different vehicles, traffic volume in peak hour and directional distribution. More details about the study location are given in the following section.

2. Details of study area
The Chittor bus stand junction is one of the important and busy intersections in Vellore city and is located 500m from Katpadi railway junction and 2 km from VIT University. In Fig.1, Google map of the intersection with some important landmarks in the city such as old and new bus stand, Katpadi railway junction, VIT University and CMC hospital are shown.

Fig.1 Google map showing the study location

The SH-59 (Thiruvalam-Venkatagirikottah Road) intersects SH-9 (Cuddalore-Chittor road) at this three-legged T-type intersection. NH-234 (Mangalore to Villupuram) also passes through this

intersection. The SH-9/NH-234 is a four lane road with two lanes in each direction. The SH-9 is a two lane road with one lane in each direction. As there is no ring road connecting these national and state highways, all the bypassable traffic are passing through this particular intersection which causes traffic congestion in peak hours. In addition to the bypassable vehicles, all the local vehicles which come from Vellore fort and Sathuvachari towards Katpadi railway station and VIT also pass through this intersection only. Hence the vehicles experiences high delay during peak hours and this is a major motivation for carrying out the present study. At present, the traffic is controlled by traffic police manually that too only during peak hours. Traffic data collection using video survey is discussed in the following section.

3. Data Collection and Extraction
The conventional way in which the traffic data collection is done is to put traffic enumerators who will stand on the roadsides and will note down the class-wise number of vehicles in a sheet of paper. There are two problems with this manual data collection. One is, it is not economical especially if more number of enumerators was employed and the other one is these enumerators sometimes may forget to note down the vehicles especially if the traffic is high. In order to overcome these problems, video data collection is generally preferred. The main advantage is we can extract the traffic flow data at any desired time interval by simple playing the collected video. In the present study also, the same has been adopted. A high rise building having a wide area coverage at the intersection was selected and traffic recording was done using SONY Handycam. Eight hrs. of video recording from 7 to 11 am and 3 to 7 pm was carried out on 8th December, 2017. A snapshot from the taken video is shown in Fig.2.

Fig.2 Snapshot from the video showing Chitoor bus stand intersection

For volume extraction, 6 directions of traffic movement were considered and were listed here. (1). From Vellore towards Katpadi (direction number 1 in Fig.3); (2). From Vellore towards VIT University (direction number 2 in Fig.3); (3). From Katpadi towards Vellore (direction number 3); (4). From Katpadi towards VIT (direction number 4); (5). From VIT towards Katpadi (direction number 5); (6). From VIT towards Vellore (direction number 6). To bring the heterogeneity in vehicle classes, five vehicle classes or modes were considered and they are two-wheelers, three-wheelers (autos and share autos), passenger cars, light commercial vehicles (LCV) and heavy motorized vehicles (HMV) which includes buses and trucks. The traffic volume in 5 min. intervals from 7 am to 11 am and 3 to 7

pm in all the six directions of traffic was manually counted using the video data collected. The next step of converting the class-wise traffic volumes to equivalent passenger cars (PCU) was done using the PCU factors given in IRC 106 [4]. The PCU factors used are 0.75, 2, 1, 1.4 and 2.2 for two-wheelers, three-wheelers, cars, LCVs and HMVs respectively. Both the class-wise volumes and PCU converted traffic volumes were analyzed thoroughly to study the traffic conditions at the selected intersection and the analysis results are given in the following section.
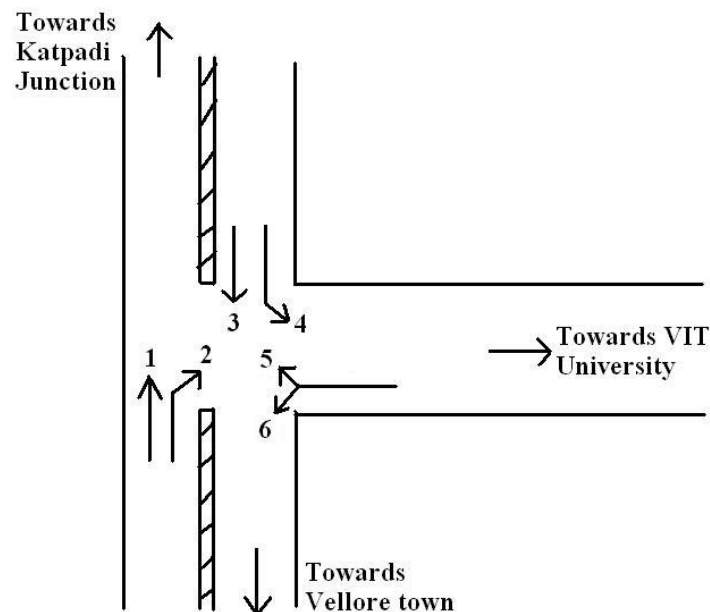

Fig.3 Direction-wise traffic movement diagram at Chittor bus stand intersection

4. Analysis of Traffic Flow

The modal share of various vehicle types was calculated using the extracted traffic volume data and the results are shown in Fig.4. It can be seen from Fig.4 that 32,348 two-wheelers have observed during the analysis period of eight hours, which accounts to 66% of the total traffic. Next to motor cycles, 8113 autos were observed, which amounts to 16% of the total traffic. Adding both, two wheelers and three wheelers comprise 82% of the total traffic volume at the selected intersection. The reason for this high proportion is that, for office/educational trips, the mode choice is two-wheelers or autos/share autos. A traffic study conducted in Chennai revealed that two-wheeled vehicles constitute about 45%, three wheelers such as autos constitute 6%, cars and SUVs constitute 47% and HMVs counts to only 2% [5]. The proportion of cars in cities like Chennai is about 50% of the total traffic as the length of the trips are usually in the range of 20 to 40 km and hence people preference is mostly cars or SUVs for such longer trips. However, the proportion of cars is only 11% of the total traffic in the present study. The possible reason is that, for office trips people prefer two-wheelers or motor cycles than cars as the trip lengths are generally small in the range of 5 to 10 kms in medium sized cities like Vellore. But as the city grows, the trip length will increase substantially and people may prefer to use cars than two-wheelers. The LCVs and HMVs proportion is 7% of the total traffic. In cities like Chennai, Delhi, Bengaluru, the entry of heavy vehicles into the city during peak hours were prohibited in order to ensure smooth and efficient flow of traffic within city limits. However, it may not be possible to implement such restriction in Vellore because there is no circular ring road exist at present for these heavy vehicles to move.
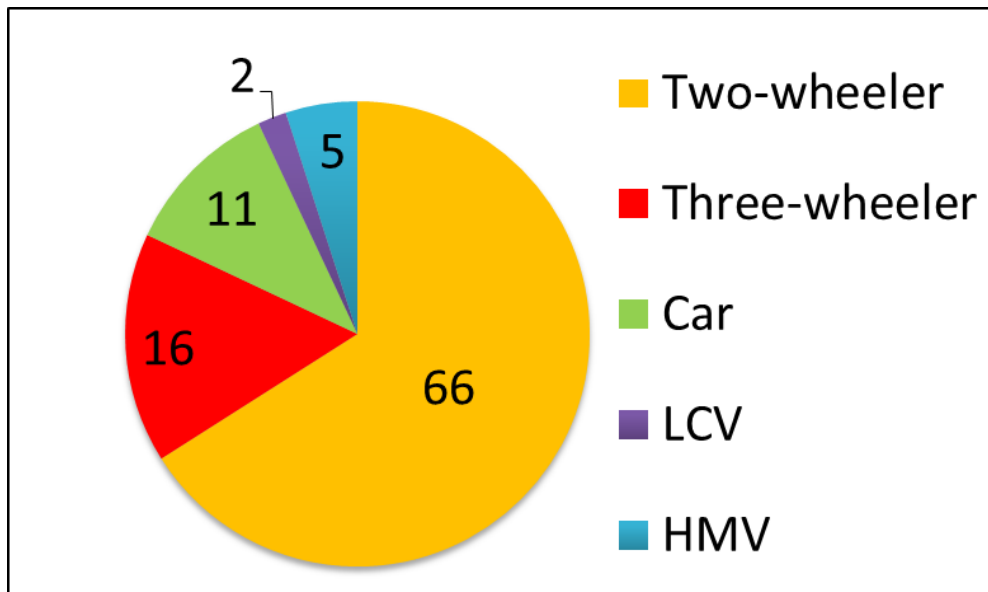
Fig.4 Percentage composition of various vehicle types

The direction-wise flow of traffic in terms of total PCU's is shown in Fig.5. As anticipated, the directions-1 & 3 have exhibited higher traffic flow when we compare it to other directions as it mainly contains through or direct traffic. Next to directions-1 & 3, directions-2 (Vellore to VIT University) & 6 (VIT to Vellore) were showing higher traffic flow. In morning, direction-2 was showing higher flow as it mainly consists of office and educational trips towards VIT and other institutions in Katpadi-Tiruvalam road. In evening, direction-6 was comparatively higher as it indicates the return travel from office to home.
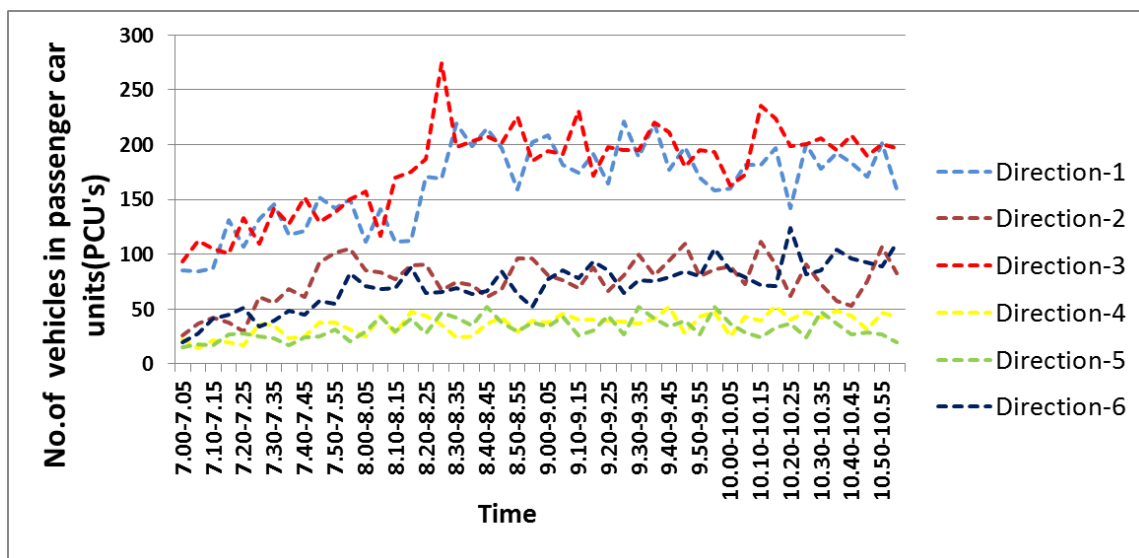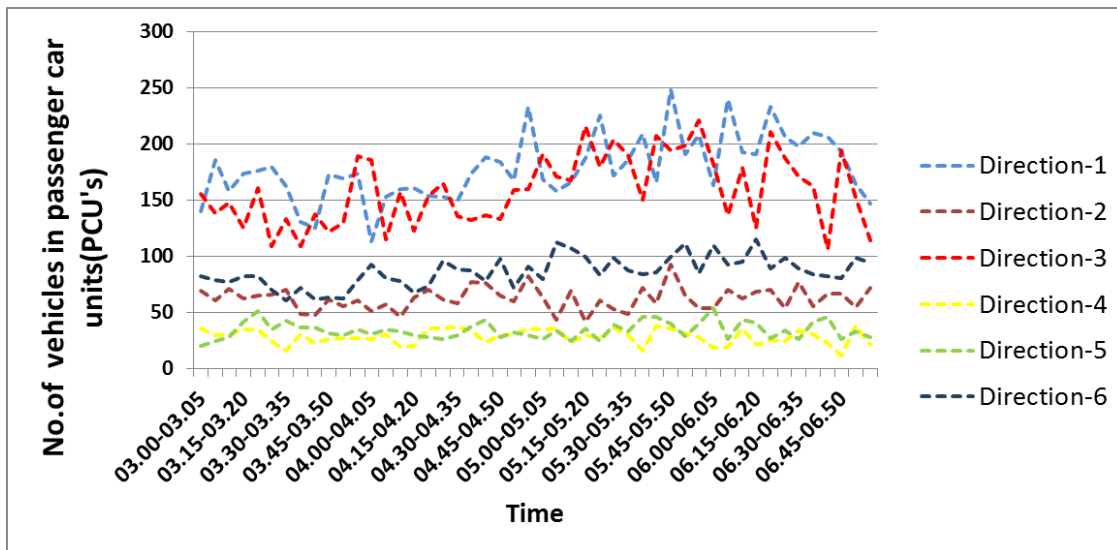

Fig.5a Direction-wise traffic flow in morning

Fig.5b Direction-wise traffic flow in evening

The total number of vehicles in PCU's is shown in Fig.6. It was observed that, the highest hourly volume is 7573 PCU's between 9.30 am and 10.30 am during morning and 7336 PCU's between 5.40 pm and 6.40 pm in evening. As per IRC-92 [6], when the total traffic is greater than 10,000 PCU's in one hour, then the flyover may be justified at the intersection. But in the present case, the total volume is only 7573 PCU's, which is less than the limit of 10,000 PCU's and hence a flyover or interchange is not required at present. By considering a 10% growth in traffic every year [7], in 2021, the traffic volume may go beyond 10,000 PCU's and may warrant or require a flyover at the selected intersection.
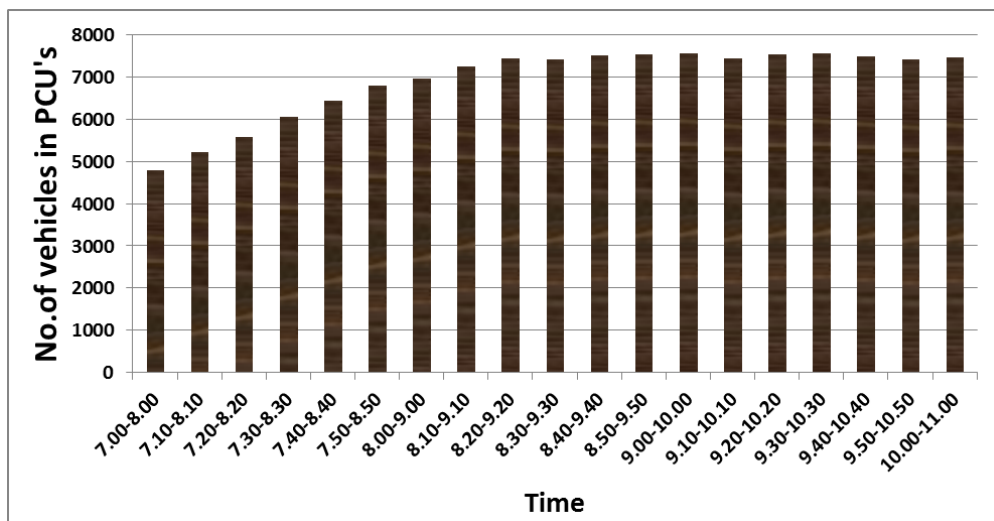

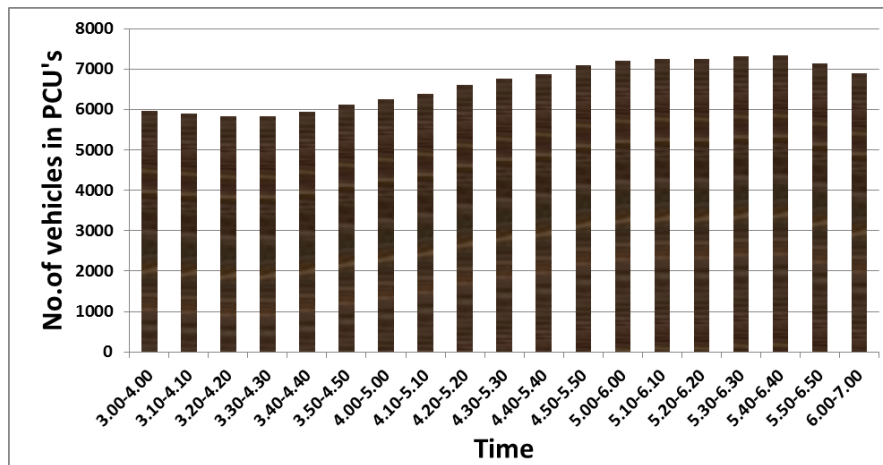Fig.6a Total number of vehicles expressed in PCU's during morning

Fig.6b Total number of vehicles expressed in PCU's during evening

5. Concluding Remarks

Urbanization in cities is a serious issue in developing countries like India. More people are migrating to metro cities and this phenomenon of urbanization results in the vehicular growth in the cities. As Vellore city is on the Chennai - Bengaluru national highway and is close to Chennai, the city faced a tremendous urban growth in recent years. It is gradually changing from a town to a metropolitan city. As a first step to solve the traffic problems in Vellore, a busy intersection namely Chittor bus stand intersection near VIT was selected and traffic study was carried out through video surveys. The survey data was carefully analyzed to find the percentage share of different vehicle types, direction-wise distribution and morning & evening peak hour traffic volume. The results would be very useful to traffic police authorities to identify suitable traffic control measures and implement it.

6. References

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