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Intersection Improvement at Moolakadai along Grand Northern Trunk Road in Chennai

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Abstract

To improve the traffic flow at the Moolakadai intersection along Grant Northern Trunk road of north Chennai, traffic survey is conducted which include road inventory and volume count along the various arms towards the intersection. Volume accumulation curves are developed and peak volume and peak time is obtained. From the analysis it is found that the peak volume is of 9556 passenger car equivalence during 18 to 19 hours at this intersection. Volume to capacity ratio is found greater than one which makes high level of congestion and poor level of service. To manage this Transport System Management concepts are suggested in various scenarios which may reduce the volume lesser than the capacity.

Keywords: Traffic Congestion, Travel Demand Management, Traffic Survey, Transport System Management, Volume Count

1. Introduction

The network of roads is used by people as a means of transport. The traffic is growing at rapid rate in urban areas of India and this is due to urbanization. The management of traffic operations on the limited road network of the cities has become a big task[1].India has the major roads of more than 4.7 lakhs running km in 2014[2]. The density of road network in Tamil Nadu (TN) is higher than the national average. TN has the road length of two lakhs km out of which 14500km are National and State Highways[3]. Transport demand in most Indian cities has increased substantially, due to increases in population as a result of both natural increase and migration from rural areas and smaller towns. India's urban population is growing at an average rate of around 3% per annum. It has almost doubled during the period between 1981 and 2011 from 160 million to 348 million[4]. The number and size of cities has also increased considerably. Chennai is the capital city of the State of TN located on the south eastern coast of the country and also the gateway of South East Asia, needs to wrestle itself against the traffic congestion.

The economic base of the Chennai city is a mixed one with small-scale industries and commercial activities distributed over the space of the city. Developments are observed mainly along major transportation corridors like Grand Southern Trunk Road, Grand Western Trunk Road, Grand Northern Trunk Road (GNT Road), Old Mahabalipuram Road and East Coast Road. The quantification of present and future traffic load at Moolakadai intersection on GNT road in Chennai is highlighted and it is based on the traffic survey carried out at that intersection, which are expected to help in providing relief to the existing and growing congestion problems at the intersection. The fundamental approach is to retain possible existing pattern of streets but to alter the pattern of traffic movement on these, so that the most efficient use is made of the system. Traffic Management is suggested using Transport System Management (TSM) concept.

Travel Demand Management (TDM) was applied which includes land use transportation planning to minimize need for travel[5]. TDM was more effective strategy to solve the problem of urban traffic. Aiming to ease traffic jam through implementing the strategies to guide and regulate the traffic demand. Analysis of adaptability of TDM to urban traffic and methods of evaluation put forward would establish a complete comprehensive evaluation system[6]. Intersections of Beijing's central urban area were

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focused. They studied the traffic facilities, motor vehicles volume, pedestrian volume, pedestrian traffic conflict, pedestrian traffic law violation rates. Based on extensive survey data appropriate measures to improve pedestrian safety is recommended. This includes improving pedestrian traffic compliance rate, adding more crossing streets facilities for pedestrian[7]. A model was developed to create a traffic restriction zone and its effects on the network functional factors were investigated then the model was evaluated by simulation[8]. Traffic operation was improved and took advantage of the space resource, left-turn vehicles waiting area and straight vehicles waiting area were adopted separately at intersection such as link delay, queue length, link average speed and passing vehicles, the simulation results indicate that the improving effect of following control strategy was superior to the underutilizing control strategy[9]. Traffic signal synchronization was a traffic engineering technique of matching the green light times for a series of intersections to enable the maximum number of vehicles to pass through, thereby reducing delays. Synchronizing traffic signals ensured a better flow of traffic and minimizes fuel consumption and pollutant emissions. They provided a solution to the traffic signal problem via simulation[10]. The review of literature extracts the concept of TSM and TDM that are used in various countries.

2. Study Area

Intersection is as an area where two or more roadways cross each other. This area is designated for the vehicles to turn to different directions to reach their destination. The study of intersections is very important for the traffic engineers especially in the case of urban scenario. GNT Road consists of three intersections. They are located at Basin Bridge, Vyasarpadi and Moolakadai. Moolakadai is the gateway of North Chennai. Moolakadai intersection is the place where GNT Road (Chennai-Kolkata Highway NH_5) and Madhavaram high roads are intersecting. High traffic congestion is found due to large movement of heavy vehicles which has to pass through this intersection to reach Chennai core. Much of the commercial and residential developments affected by this traffic problem occurred in the northern side of the Moolakadai intersection and it is shown in Figure 1. Madhavaram is one of the heavily populated locations at 13.15°N 80.2°E. It is the new constituency abutting the city, is an amalgamation of urban middle class and rural population spread across local bodies of various grades. The majority of the populations are

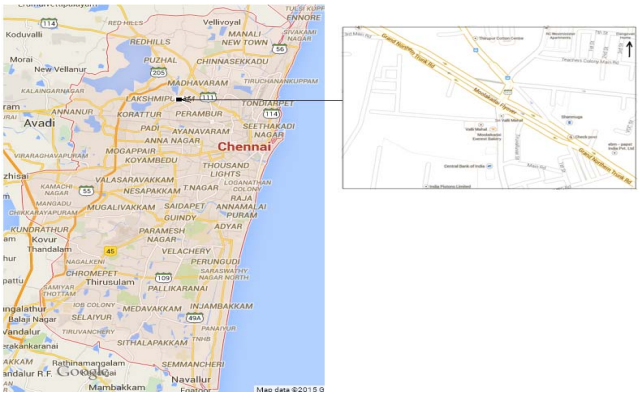

Figure 1. Moolakadai intersection along GNT road.

reliant on these industries. This area has a large population of casual labours working in non formal sectors. In the interest of the economy and trade and to decongest the Central Business District, CMDA has developed the truck terminal at Madhavaram over an extent about 100 acres which is close to Moolakadai. Presently the authority is building a flyover at this intersection for a length of 450m and 9m wide, with bitumen-topped service lane measuring 7.5m wide on both the sides. Hence the movement of heavy vehicles is large in the intersection. It causes heavy traffic at Moolakadai intersection. This intersection is manually controlled since the flyover work was started. Roads leading to off the GNT road are unpaved dirt tracks. On the GNT road even pedestrians finding it difficult to cross most of the time. Proposal of short term measures can help to make the flow of traffic smooth on the GNT Road. The congestion in the study area is shown in Figure 2.

3. Traffic Survey

Road inventory survey and volume count are conducted at the intersection. The traffic volume data is manually recorded in four locations of the intersection and the existing flow are shown in the Figure 3.The volume count is conducted between 8 to 20 hours. The width of the Madhavaram high road is 18 meters, Vyasarpadi and Redhills high road is 24 meters and it has unfinished footpath of lesser than one meter wide. The road occupied by encroachers and unauthorized parking on both the sides all along the roads which bring down velocity of vehicle flow. Passenger Car Equivalency (PCE) conversion factor is used to bring various vehicles into a single unit as per Indian Road Congress (IRC-106-1990) specification. Conversion factor used for car, van and auto is 1.0, for truck and bus

Figure 2. Traffic condition at Moolakadai intersection.

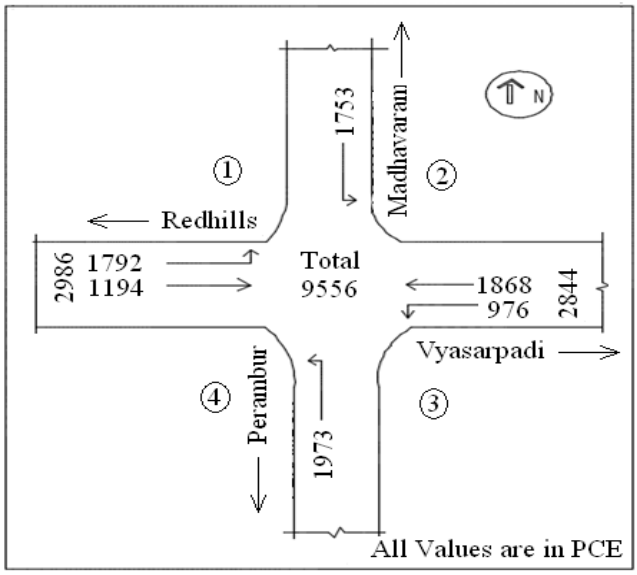

Figure 3. Existing traffic flow at Moolakadai intersection.

are 2.2 (less than 5% composition in the traffic stream) and for two wheeler it is 0.75 (more than 10% composition in the traffic stream). The volume accumulations are plotted as graphs and shown in Figure 4–7. From the graph morning peak is found as 2500 PCE on Redhills road (location 1), Vyasarpadi road (location 3) and 2200 PCE on Madhavaram road (location 2) Perambur road (location 4), between 9.30 to 10.30 hours and evening peak is found as 2986 PCE on Redhills road (location 1), 1753 PCE on Madhavaram road (location 2), 2844 PCE on Vyasarpadi road (location 3) and 1973 on Perambur road (location 4) between 18 to 19 hours. The peak volume at Moolakadai intersection is of 9556 PCE in the evening hours.

The traffic volume to capacity ratio is calculated to measures the congestion level. As per IRC: 106-1990 states that an intersection is severely congested if the V/C ratio is greater than 1.0. The design capacity of intersection is referred from IRC 86-1983.Volume-to-Capacity ratios of all roads are shown in the Table 1.The peak volume in one hour at the intersection is 9556 PCE but the actual design capacity of the roads at the intersection is 5400 PCE. The average of V/C ratio is 1.76 and therefore the congestion is severe at this intersection, hence improvement measures have to be recommended to improve the flow.

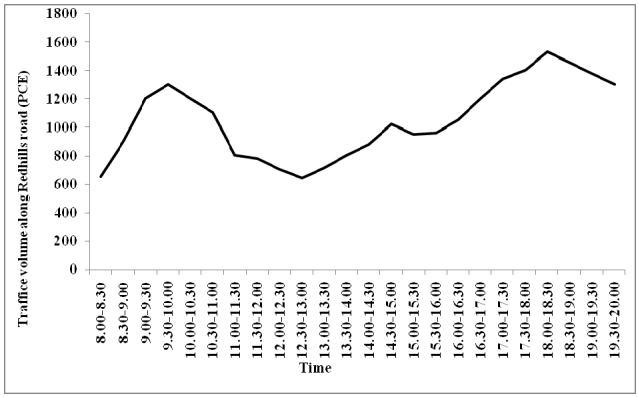

Figure 4. Volume Accumulation at Location 1.

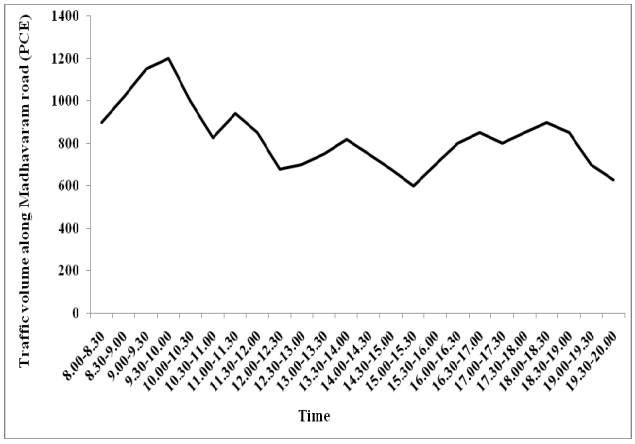

Figure 5. Volume Accumulation at Location 2 (N to E).

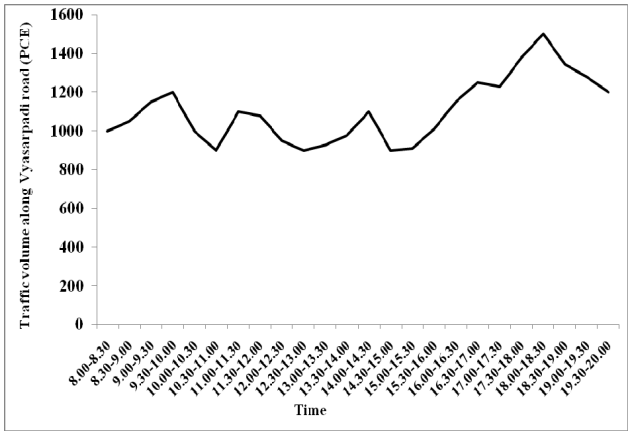

Figure 6. Volume Accumulation at Location 3.

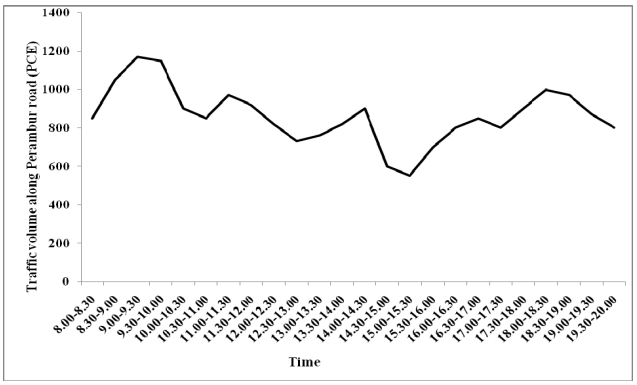

Figure 7. Volume Accumulation at Location 4 (S to W)

Table 1. Volume to Capacity ratio of roads.

Name of the Road	Type of flow	Volume (V) PCE	Capacity (C) PCE	V/C
Madhavaram road (N)	2 lane 2 way sub arterial	1753	1200	1.46
Vyasarpadi road (E)	2 lane 2 way arterial	2844	1500	1.89
Perambur road (S)	2 lane 2 way sub arterial	1973	1200	1.64
Redhills road (W)	2 lane 2 way arterial	2986	1500	1.99
For the Intersection	-	9556	5400	1.76

4. Recommendations

The TSM measures are suggested by restricting the selective modes in three different scenarios is discussed. As scenario one the two wheelers from Redhills road, Madhavaram road and Vyasarpadi road can be diverted to nearby local streets with low very volume which has a minimum width of 6m as T turn and Q turn in one way flow to reach their destination. Based on this suggestion on Redhills road the volume reduced from 1792 to 600 PCE. Along Madhavaram road the volume gets reduced from 1753 to 600 PCE and along Vyasarpadi road it is reduced to 350 from 976 PCE which reduce the V/C ratio to 1.21. The reduction in volume will be of 2971 PCE and the total volume will reduced to 6585 (9556-2971) PCE. Removing the encroachment and avoiding roadside parking upto 300m from the intersection will improve the traffic flow. As second scenario if the bridge is opened for traffic the east (1868 PCE) and west (1194 PCE) traffic will be lifted to higher level which will reduce the intersection volume to 6494 (9556-(1868+1194)) PCE and as third scenario, the first and second scenarios may be combined and the effect will reduce the volume to 3523 (9556- (2971+1868+1194)) PCE which is very much lesser than the capacity. Further diverting the vehicles from west, north and east towards the intersection to the parallel minor roads will considerably reduce the volume at intersection and increase the level of service. From the earlier study (CMDA report) the peak value is 8,525 PCE in 2008, it is increased to 9556 PCE in 2015 and which may increase to 10290 PCE in 2020 by linear forecast. If these scenarios are adopted the traffic volume will be less and therefore V/C ratio will drag. Thus, TSM helps on efficient use of the roadway system.

5. Conclusion

There are three intersections along GNT road of Chennai which are located at Basin Bridge, Vyasarpadi and Moolakadai. This area is covering much of the commercial and residential developments. Moolakadai intersection is the place where GNT Road (Chennai-Kolkata Highway NH_5) and Madhavaram high roads are intersecting. Four roads leading to Madhavaram (N), Vyasarpadi (E), Perambur (S) and Redhills (W) are meeting at this intersection. Road inventory survey and volume count are conducted. The width of the Madhavaram high road is 18 meters, Vyasarpadi and Redhills road are 24 meters and it has unfinished and undulated surface struggling with a fly over construction. Roads are occupied by encroachers and unauthorized parking on both the sides which brings down velocity of vehicle flow and leads poor level of service. From the survey data the volume accumulations curves are plotted. From the graph morning and evening peak volume at Moolakadai intersection is found and 9556 PCE as peak of peak in the evening hour (18-19). As per IRC the actual design capacity of the roads at the intersection is 5400 PCE and the average V/C ratio is 1.76 and hence improvement measures to be recommended to improve the flow. The TSM measures are suggested in three different scenarios. As scenario one the two wheelers from Redhills road, Madhavaram road and Vyasarpadi road will be diverted to nearby streets which will reduce the total volume to 6585 PCE. As second scenario if the bridge is opened for traffic, the east and west traffic will be lifted to higher level which will reduce the intersection volume to 6494 PCE and as third scenario, if the first and second scenarios may combined and will reduce the volume to 3523 PCE. Further diverting the vehicles

from west, north and east towards the intersection to the parallel minor roads will considerably reduce the volume at intersection and increase the level of service. Thus, TSM will help in the efficient use of the roadway system.

6. References

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