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INTERSECTION IMPROVEMENT AT FORESHORE ESTATE ALONG DGS DINAKARAN SALAI IN CHENNAI

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ABSTRACT

Rapid urban development generates enormous number of vehicles on road which leads to high level of congestion. Assessment of traffic volume provides measure for safe and efficient flow of traffic. Foreshore Estate intersection is in Southern part of Chennai city along Santhome high road has been selected for study. The road inventory survey has been carried out to collect the road geometry such as width of the road, median, footpath etc. The vehicle volume has been collected by performing the survey at four arms of Foreshore Estate intersection. The traffic accumulation graph is developed for the traffic volume at the study intersection, the peak hour and corresponding traffic volume has been assessed. Short and long-term measures are suggested to manage the traffic congestion. Asashort term measure change in directional movement and as a long-term measure reconstruction of broken bridge from Pattinambakkam to Besent Nagar are suggested and this will ease the traffic volume at Foreshore Estate Intersection.

Keywords: Traffic congestion, Intersection study, Traffic survey, Traffic management measures, Transport System Management

1. INTRODUCTION

Exponential increase in vehicle ownership lead high volume of traffic and the constant contradiction between traffic demand and supply, congestion occurs oftentimes. Estimate their influence to the entire road network study area; andhow to improve the connectivity and accessibility of the whole road networkthrough local traffic reformation, have become important issues to transportation planners and managers. Traffic congestion can be characterized by the decrease in speed, the increase in travel time and the increase of vehicle's queue on the road. In addition, traffic congestion happens when the vehicle volume exceeds the road capacity. The road intersection will not sustain if its capacity exceeds the volume, but this condition exists in certain intersections and it has dominated over the entire City. An intersection is a point where two or more roads either meet or cross at any grade. An intersection may often be controlled by traffic signals and may have a roundabout with traffic islands. Intersections are crucial to a street's performance. They control the vehicle speed, safety, costand efficiency. Turning movements will directly affect the safety and efficiency, making right turn is the key design factor in intersection improvement and operation. Other improvements can also be made to increase safety and capacity, thus reducing congestion on the road. The most common strategies may include improving signal timing, removing elements that hinder sight distance, making drivers' awareness that they are approaching an intersection and improving bicycle or pedestrian facilities at theintersection. To assess the existing traffic flow at a study area by doing traffic survey and analyze the data which will help to suggest improvement measures, be the objectives of this study. The improvement measures will minimize the level of congestion and improves smooth flow of vehicles.

2. REVIEW OF LITERATURE

Santosh A. Jalihal et al (2005)[1] said that the revolution in the automobile industry and liberalized economy had led to tremendous increase in the vehicle ownership levels. This had resulted in changing traffic characteristics on road network. They analyzed the changing traffic composition trend, speed characteristics and travel patterns by taking few case studies. Further, the impact of changing traffic composition trend and emerging issues thereof were discussed. Kazunori Hokao and Shihana Sulaiha Mohamed (2011)[2] said that new developments were one of the major causes of traffic congestion in many of the major cities of developing countries, due to the absence of adequate mitigation measures. They reviewed the various measures that were being taken to mitigate the traffic impact of developments and to make suggestions for the wider and more effective implementation of these measures. The process of traffic impact mitigation in Bangkok was examined in detail, together with two case studies in Bangkok. Sampathkumar.V et al (2014)[3] studied the intersection at Sholinganallur in Rajiv Gandhi Road, Chennai. It was one of the major junctions in Chennai Metropolitan Area which need attention to decongest. It was supported only by roadways. The increase in traffic volume with lack of sustained improvement results in congestion. Rajiv Gandhi Road had Information Technology companies with lakhs of employees travelling along this road. This intersection connects to the major regions. It struggled with more volume than the capacity which leads delay and queuing of vehicles. Traffic system management (TSM) was suggested by avoiding right turn movements and diverting the vehicles will decrease the volume. As a long term measure, a grade separator was suggested along North-South would control the volume and sustain for the coming years. Sampathkumar V et al (2015)[4] said that to improve the

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

Geethu Lal et al (2016)[5] said that the spectacular increase of number of motor vehicles on the road is mainly attributed ingeneration of traffic problems like accidents, congestions, delays etc., especially in the urban premises of developing countries. They examined the traffic problems and sustainable improvement of road intersection at Ettumanoor, India. Allan M de Souza et al (2017)[6] said that in cities, where the number of vehicles continuously increased faster than the available traffic infrastructure to support them, congestion was a difficult issue to deal with and it become even worse in case of car accidents. This problem affected many aspects of the modern society, including economic development, traffic accidents, increase in greenhouse emissions, time spent, and health damages. In this context, modern societies could rely on TSM to minimize traffic congestion and its negative effects. Traffic management systems were composed of a set of application and management tools to improve the overall traffic efficiency and safety of the transportation systems. TSM gathers information from heterogeneous sources, exploited such information to identify hazards that might potentially degrade the traffic efficiency, and then provide services to control them. They presented a classification, review, challenges, and future perspectives to implement TSM. Valeriy Kapitanov et al (2018)[7] said that a methodology for traffic management in cities provided for extensive use of computer technologies. Modern international experience showed that traffic management in the urban street and road network, requires a city-wide management system such as Intelligent Transportation System. Development of a social process model was a complicated task that can be solved under rather severe restrictions. Therefore, most traffic management tasks were not formalized but solved empirically. Eduard Zadobrischi et al (2020)[8] said that the massive increase in the number of vehicles had set a precedent in terms of congestion, being one of the important factors affecting the flow of traffic, but there were also effects on the world economy. They highlighted that the increased density of vehicles could be remedied by dedicated short-range communications systems through communications of the type vehicle-to-vehicle, vehicle-to-infrastructure or vehicle-to-everything. They said that wireless communication technologies had the potential to significantly change the efficiency and road safety, thus improving the efficiency of transport systems. An important factor was to comply with the requirements imposed on the use of vehicle safety and transport applications. They focused on simulations on the basis of symmetry models, implemented in practical cases in order to streamline vehicle density and reduce traffic congestion. The scenarios aimed at both the communication of the vehicles with each other and their prioritization by the infrastructure. Tanzina Afrin and Nita Yodo (2020)[9] said that traffic congestion was a perpetual problem for the sustainability of transportation development. Traffic congestion cause delay, inconvenience and economic losses to driver and lead air pollution. Quantification of traffic congestion were crucial for decision makers to initiate mitigation strategies to improve the overall transportation system's sustainability. They compared the current available measures on a daily and weekly traffic historical dataset. The results showed variations in congestion states while indicating a similar congestion trend. The advantages of each measure were identified and summarized the current road traffic congestion measures and provided a constructive insight into the development of a sustainable and resilient traffic management system.

3. STUDY AREA

Intersection is an area designated for the vehicles to turn to different directions to reach their destination. The study of intersection is very important for the traffic engineers especially in the case of urban scenario. Here the study location is Foreshore estate intersection at Pattinapakkam in Southern part of Chennai which is shown in Figure 1. From this intersection, Santhome high road in North which leads to Marina beach and Parrys, Foreshore estate Promenade road in East, Dr. DGS Dinakaran road in South which leads to Adyar and South canal bank road in the West which leads to Mylapore. The Foreshore estate intersection is the connecting hub of various places such as Mylapore, Pattinapakkam and Santhome. A part of DGS Dhinakaran salai and Santhome high road are passing through the Foreshore estate intersection in the southern part of Chennai. This road is lined up with official residence of ministers of Tamil Nadu State Government. This intersection comes under Mylapore constitution and it connects people from Southern part of Chennai to the Northern part of Chennai and Northto South. In the southern side of this intersection, a hush green park, a memorial of Dr.Ambedkar, TN Dr.Ambedkar law university, TN human right commission, Dr MGR Janaki college of arts and science and Meenakshi cine tone (one of the oldest cinema studio) are located. In the Western part of this intersection, there are places such as Mylapore, Triplicane and Royapettah are located. Mylapore is present in the central Chennai. It has one of the oldest residential parts of the city. Mylapore is known for its famous religious center like Sai Baba temple, Kapaleeshwarar temple, Ramakrishna Mutt and world famous Saint Thomas Church. Santhome has some premier educational institutions. Hence, it became an administrative capital of the Archdiocese of Madras-Mylapore. These include

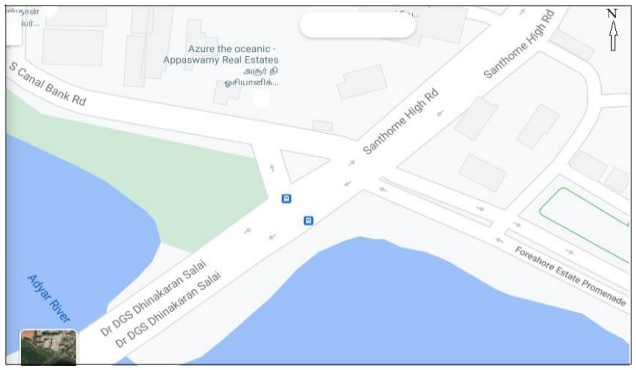

Fig.1 Foreshore Estate Intersection

Rosary Matriculation School, St. Bedes A. I. Higher Secondary School, Santhome higher secondary school,St. Raphael's girls higher secondary school and Dominic Savio matriculation school. The official residence of the Archbishop of the Madras-Mylapore Archdiocese is in Santhome which is adjacent to the Basilica.The consulates of Russia and Spain are also located in this area. The area is easily accessible by Metropolitan Transport Corporation buses and has a sprawling bus terminus near the study intersection.

4. DATA COLLECTION

Data Collection is the process of measuring and gathering information on targeted variables in an established systematic fashion. The data needed for the analysis of the traffic flow at the study area is done by road geometric survey and volume count survey. Geometric survey is used to measure the dimensions of the length and width of road, median, foot path, bus stops, pedestrian path and parking space. At the Foreshore estate intersection the vehicles moving in different directions want to occupy same space at the same time. 1200 pedestrians per peak hour also seek same space for crossing. Santhome high Road with 16m width in North, Foreshore estate Promenade road with 19.8m width in East, Dr. DGS Dinakaran road with 17m width in South andSouth Canal Bank road with 15m width in West make the intersection which is shown in Figure 2. Traffic volume study is the number of vehicles crossing a section of road per unit time. Manual method is adopted in which a group of peoples are trained to record on sheet the total number ofvehicles crossing a section of the road in desired period of time. It gives the full detail of various classes of vehicles, stream and turning movements. This method is simple to identify the peak hour and the peak volume.

The traffic volume has been studied on straight and turning movements of all four roads at the intersection between 7 and 21 hours. The count made for all vehicles which include two wheelers, three and four wheelers. Various modes of vehicles are brought into single unit for which conversion factors have been used and the volume is expressed in PCE. From the volume study it is found that

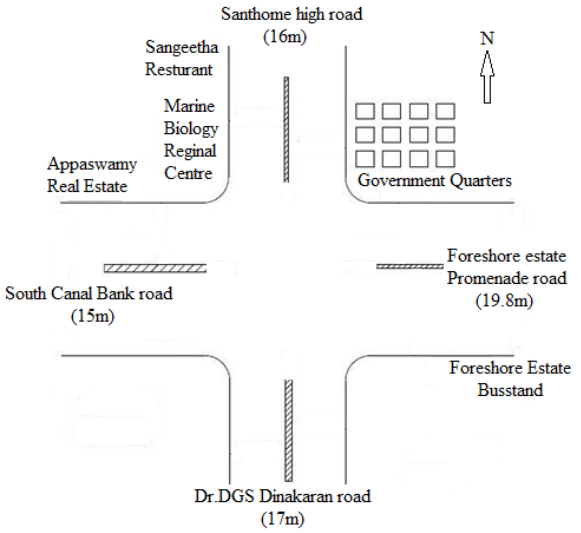

Fig.2 Geometry of Foreshore estate intersection morning and evening are very closer. The volume of morning peak is 9620 PCE occurred between 9 and10 hrs and the evening peak is 8946 PCE (18 -19 hrs) in which morning peak will be the peak of peak. Traffic accumulation graph of the study area is shown in Figure 3 which shows the gradual rise and fall in volume of vehicle movement in the study intersection. The directional movement of vehicular volume at peak hour (9-10hrs) in PCE units is shown in Figure 4. The ratio of the service volume to capacity in the peak of peak hour (9.0-10.0 hrs) at the study intersection comes around 1.34. Here the peak hour volume arrived as 9620 PCE and the practical capacity as per IRC is 7200 PCE per hour (Ref: Table 21.19 Practical capacities of four lane two-way intersection, p535, Chapter 21, Section 11, Highway capacity, "Traffic engineering and transportation planning" by L.R.Kadiyali, Khanna publishers, 8th Edition 2013, ISBN 81-7409-220-X). The volume of two-wheeler is dominating up to 58% in the model split of vehicular movement analysis at the study intersection.

5. TRAFFIC FLOW MANAGEMENT

Intersection volume study reveals that the vehicular volume is very high from Santhome high road (3134 PCE) and from Dr.DGS Dinakaran road (3202 PCE). Short term and long-term management measures are suggested to bring down the volume at the study intersection. As a short term measure, two scenarios have been suggested such as diverting towards East and West

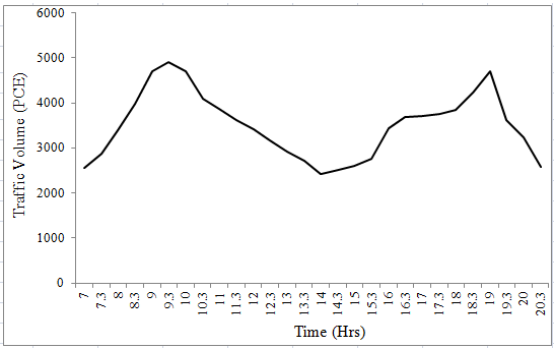

Fig.3 Accumulation of volume at Foreshore estate intersection

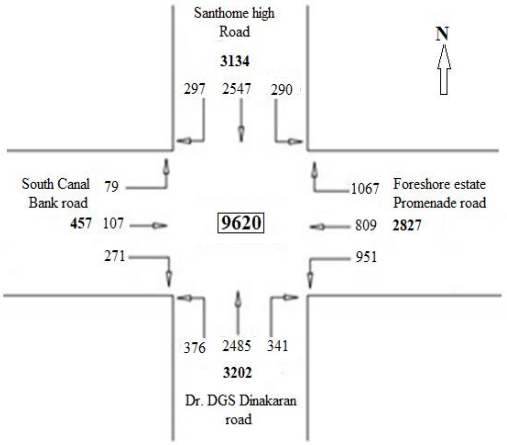

Fig.4 Directional movement of vehicular volume in PCE between 9 and 10 hrs

vehicles from Santhome highroad as a G turn which will evict 587 PCE from the study intersection and will pull down the intersection volume to 9033 PCE. At the intersection, towards West from Santhome high road vehicles may be allowed to take a West turn in the early junction itself and passing through Lazarus Church road and on Second trust main road towards South which connects towards the West on South Canal BankRoad which leads to Mylapore. Further by diverting the vehicles from Santhome high road to Foreshore estate Promenade road through Police quarter's road towards the East may avoid towards East turn at the study intersection. The suggested diversions are shown in Figure 5.

As another short term management measure it is proposed to divert the vehicles plying towards South at the study intersection from Santhome high road, may be diverted towards East near lighthouse itself and allow the vehicles to continue towards South along Foreshore estate Promenade road up to 1.83 km to Foreshore estate and reach Dr.DGS Dinakaran road using Foreshore estate Promenade road will further reduce 2547 PCE and the volume at intersection will become 6486 PCE. This road is considerably wider compared to the narrow Santhome high road allowing for faster passage of traffic volume. This proposed diversion is shown in the Figure 6. If these two proposals of diversion are implemented the volume to capacity ratio will come down to 0.90 which will ease the movement of vehicles at the study

intersection.

As a long-term management measure to reduce traffic volume at Foreshore estate intersection it is suggested toreconstruct the broken bridge and allow four way passage for vehicles. Broken bridge is across the Adyar river mouth in South Chennai and it was constructed in the year 1977. The bridge was partly collapsed due to strong currents of the riverand never been repaired. The bridge is across the Adyar estuary, bordering the backend of the theosophical society. The broken bridge connected Srinivasapuram in Foreshore estate with MRC Nagarand Adyar holds the key to decongest an entire stretch of Santhome high road and Greenways road up to Besant Nagar beach. An entry ramp at Foreshore estate junction

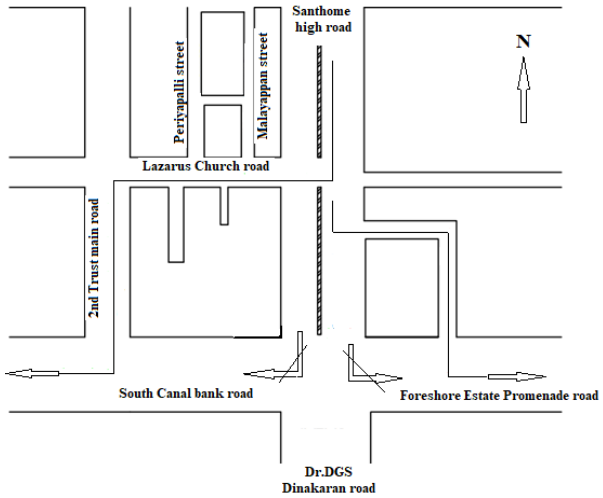

Fig.5 Proposed diversion of vehicular route at Foreshore Estate Intersection

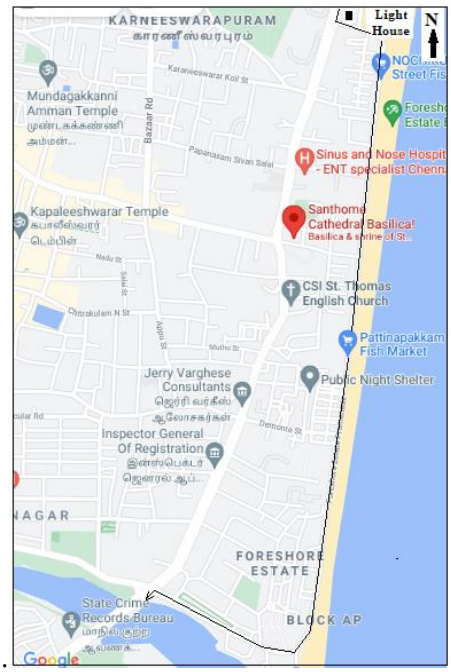

Fig.6 Proposed diversion of vehicular route from light house to Foreshore Estate Intersection

joins the main section and continues as a four lane road till Elliot's Beach. It runs for a distance of 1.8 km and joins Besant Nagar 5th avenue road at Elliot's Beach and the alignment of bridge is shown in Figure 7. Itcrosses Adyar River and passes to the west side of Broken Bridge. This reconstruction also allows swift of passage and connectivity to OMR and ECR. This would serve as an Expressway between Marina beach and Elliot's beach in Besant Nagar and it connects through Besant avenue road to join Adyar. If this bridge is reconstructed the volume of traffic will be reduced lesser than fifty percentage at foreshore estate intersection.

Fig.7 Proposed reconstruction of bridge across Adyar river mouth

6. CONCLUSION

Rapid urban development generates enormous number of vehicles on road which leads to high level of congestion. The assessment of traffic volume provides measure for safe and efficient flow of traffic. Traffic congestion can be characterized by the decrease in speed, the increase in travel time and the increase of vehicle's queue on the road. Traffic congestion happens when the vehicle volume exceeds the road capacity. On road an intersection is a point where two or more roads either meet or cross at any grade. For study Foreshore estate intersection which is at Pattinapakkam in South Chennai along Santhome high road has been selected. This intersection involves Santhome high road, Foreshore estate Promenade road, Dr. DGS Dinakaran road and South canal bank road in four directions. The road inventory survey and volume survey has been carried out. Traffic volume has been studied on straight and turning movements of all four roads at the intersection between 7 and 21 hours. The volume of morning peak is 9620 PCE occurred between 9 and10 hrs and the evening peak is 8946 PCE (18 -19 hrs) in which morning peak will be the peak of peak. The study reveals that the vehicular volume is very high from Santhome high road (3134 PCE) and from Dr.DGS Dinakaran road (3202 PCE). The ratio of the service volume to capacity in the peak of peak hour (9.0 to 10.0hrs) at the study intersection comes around 1.34. The model split of vehicle within the peak hour in the intersection two-wheeler is dominating (58%).

Short term and long-term management measures are suggested to bring down the volume at the study intersection. As a short term measure, two scenarios have been suggested such as diverting towards East and west vehicles from Santhome highroad as a G turn which will evict 587 PCE from the study intersection and will pull down the intersection volume to 9033 PCE. At the intersection, towards West from Santhome high road vehicles may be allowed to take a West turn in the early junction itself and passing through Lazarus Church road and on Second trust main road towards South which connects towards the West on South Canal BankRoad which leads to Mylapore. Further by diverting the vehicles from Santhome High Road to Foreshore Estate Promenade road through Police Quarters Road towards the East may avoid towards East turn at the

study intersection. As a second short term management measure it is proposed to divert the vehicles plying towards South at the study intersection from Santhome high road, may be diverted towards East near lighthouse itself and allow the vehicles to continue towards South along Foreshore estate Promenade road up to 1.83 km to Foreshore Estate and reach Dr.DGS Dinakaran road using Foreshore estate Promenade road will further reduce 2547 PCE and the volume at intersection will become 6486 PCE. If these two proposals of diversion are implemented the volume to capacity ratio will come down to 0.90 which will ease the movement of vehicles at the study intersection.

As a long-term management measure it is suggested to reconstruct the broken bridge which runs for a distance of 1.8 km and joins Besant Nagar fifth avenue road at Elliot's Beach. It will crosses Adyar river and passes to the west of Broken Bridge. If the bridge is reconstructed the volume of traffic will be reduced lesser than fifty percentage at foreshore estate intersection. This reconstruction also allows swift of passage and connectivity to OMR and ECR easily.

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