Estimation and Analysis of Traffic Density in Cuddalore District to Minimize Accidental Hazard with the Help of Process Flow Method

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Abstract - The revolution in the automobile industry and the liberalized economy has led to tremendous increase in the vehicle ownership levels. This has resulted in changing traffic characteristics on road network. In the paper, an attempt has been made to analyze the changing traffic composition trends, speed characteristics and travel patterns by taking few case studies. Further, the impact of changing traffic composition trends and emerging issues thereof are discussed. The aim of this paper is to suggest measures so as to reduce the accidents at road intersections and also to allow the orderly movement of vehicles into the intersection without traffic jam. Three intersections in Cuddalore were selected for the study. The first intersection is at and the Income Tax Department office, the Second intersection is at Cuddalore bypass and the Third intersection is at Across Cuddalore Port Railway station, these intersections have been chosen as there is the large flow of traffic at these intersections. Vehicular traffic movement is greater in these intersections, hence the probability of accidents will be more in these three intersections To reduce such accidents, this paper suggests a traffic regulatory device in the form of traffic signals at all three intersections and foot-over bride for pedestrians wherever required. Traffic census was carried out by the manual method at three intersections from 6:00 hours to 21:00 hours on all days. The data obtained satisfied the warrant for operating the traffic signal at all three intersections. The paper gives the detail of Traffic Flow and Road Capacity Cuddalore in the design of traffic signals by different methods at intersections which will permit the best turning movements in Cuddalore the design of pedestrian foot-over bridge wherever required.

Keywords - Accident, Automobile, Census, Process flow method, Traffic density.

1. INTRODUCTION

Traffic flow is a serious concern with traffic engineers all over the world are trying to work out. Due to improper traffic management, congestion increases the uncertainty in travel times leading to human stress and unsafe traffic situations [1]. Traffic engineering is a branch of civil engineering that uses engineering techniques to achieve the safe and efficient movement of people and goods on roadways [2] [3]. It focuses mainly on research for safe and efficient traffic flow, such as road geometry, pavements and crosswalks, segregated cycle facilities, shared lane marking, traffic signs, road surface markings and traffic lights [4] [5] [6].

Traffic analysis is the process of intercepting and examining messages in order to deduce information from patterns in communication. The essential components of traffic analysis are the traffic load that will use the facility (demand, need, market) and the ability of the system to handle the traffic load (supply, service, capacity) [7].

Traffic Analysis can be split into two well defined areas:

- Traffic Volume - This is the role of the Traffic Engineer and does normally concern the Civil Engineer. This is not relevant to determining the load on the road, only the size and layout.
- Traffic Loading - This is the role Of the Pavement Engineer and involves determining the loading on the road t be carried forward to the Pavement Design.

The measurement of traffic is generally considered to be in terms of the flow of people vehicles, bicycles, or units. Flow will be expressed in terms of units (people, vehicles, etc) per unit of tune when the time unit is omitted it is either implied or it refers to some other form of delineation such as what will or has happened in a system, vehicle, etc. Some commonly used units of measurement for traffic flow are vehicles per day, vehicles per hour, passengers per day, tonne-kilometres, tons, cubic yards, and so on. In conventional highway terminology, the common measurements of traffic flow are vehicles per day or vehicles per hour. The rate varies continually from hour to hour and within any hour [8]. Flow can also be expressed as a basic linear model which gives the total volume or amount of occurrence 1 based on a mean rate of occurrence for a unit multiplied by the number of units [9].

Intersections in the highway network like of Cuddalore have a significant effect on the operation and performance of the traffic system. There are two broad categories of intersections namely at grade and grade separated. The traffic flow at level intersection may be uncontrolled, priority type or controlled. At the controlled intersections different directions of flow share the same road space and flow is segregated in terms of time. Due to sharing of the same space (in terms of time) by different directions of flow the traffic moves like stop and go situation. Due to this situation capacity for signalized intersection is defined and Measured in a different way than uninterrupted flow [10]. The US Highway Capacity Manual 2000 edition defined the capacity of a facility as "the maximum hourly rate at which persons or vehicles can reasonably expect to traverse a point or uniform segment of a lane or roadway during a given time period under prevailing roadway, traffic, and control .conditions'. Basic capacity for signalised intersections is defined in terms of the saturation low rate, i.e., the capacity of the lane or approach assuming that the signal is green

at all times [11]. The ideal conditions at a signalised intersection approach are 12 ft lane widths, level Approach grade, all passenger cars in the traffic stream, no left- or right-turning vehicles in the traffic stream, no parking adjacent to a travel lane within 250 ft of the stop line and intersection located in a non-CBD area [12]. Prediction and knowledge of capacity are fundamental in the design, planning, operation, and layout of road sections. Capacity is greatly influenced by roadway, traffic and control conditions [13].

Road junctions are the places where accidents generally occur unless proper precautions are taken in the design or layout. Safety of vehicular traffic and pedestrians is very essential at road junctions by providing proper signal and also for the orderly movements of vehicles [14].

A road is a thoroughfare, route, or way on land between two places, which typically has been paved or otherwise improved to allow travel by some conveyance, including a horse, cart, or motor vehicle. Roads consist of one, or sometimes two, carriageways each with one or more lanes and also any associated pavement and road verges. Roads that are available for use by the public may be referred to as public roads or highways. Careful design and construction of roads can increase road traffic safety and reduce the harm (deaths, injuries, And property damage) on the highway system from traffic collisions [15].

The study of traffic engineering may be divided into many major sections such as:

- Traffic characteristics
- Traffic studies and analysis
- Traffic operations — control and regulation
- Planning and analysis
- Geometric design
- Administration and management
- Research

Few intersections in Cuddalore were selected for study. E.g., intersection at the south gate of Kv mall (South Car Street), intersection in front of Mangalam lodge (S P Koil Street), intersection in front of National Departmental Store (Junction at South and East Car Street), intersection opposite to Ii.P Petrol pump (Junction at West and North Car Street intersection at the three way crossing beside of the union bank of India) these intersections have to chosen as there is large flow of traffic at these intersection [2] [15] [16].

2. METHODOLOGY

2.1 Traffic survey an analysis

Traffic surveys and analysis are an integral component of a comprehensive Traffic transportation study. Appreciation of existing traffic and travel characteristics is extremely important for developing comprehensive traffic and transportation plan. For better understanding of travel pattern within the study area and its interaction with regions external area, a total of three zones, designated as Traffic Analysis Zones have been identified. The zoning system has been developed based on the density of traffic flow, delay time, speed characteristics and based on network connectivity and importance of town with respect to Chidambaram [17] [18].

Secondary data have been collected from the Transport and Highway Department, Municipal Corporation, and Traffic Department in Cuddalore. Secondary data have been collected to describe.

- Characteristics of existing demand for travel.
- Accident details on the road network.
- Existing supply of transport infrastructure including fleet size of mass transport system, operation, cost, performance, regulation and utilization.
- Demographic and socio — economic characteristics.
- Present and proposed land use patterns.
- Planned transport investments, policy changes and other government actions.
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The primary traffic surveys were conducted for appreciating the existing traffic and travel demand characteristics and to prepare the transport infrastructure improvement plans. They are as follows:

2.2 Road inventory survey

The objective of this survey was to assess the physical characteristics and condition of roads within the study area, identify physical constraints and bottlenecks, and assess potential capacity and to identify the extent for future development and improvement.

2.3 Classified Traffic Volume Count Survey

These surveys were conducted in order to appreciate the traffic characteristics in terms of average daily traffic, traffic composition, peak hour traffic and directional split at individual survey locations at the cordon lines.

3. RESULTS AND DISCUSSIONS

3.1 Origin-destination survey

The main objective of origin — destination survey was to obtain information on travel pattern of passenger and goods vehicles and the cordon line along with the trip desire in terms 1 destined to or originated from and through trips to the study area (table 1).

Table 1: Origin - Destination Survey Locations and Schedule

Location and Road Section	Date	Duration
By pass near Cuddalore bus stand, cuddalore	19.03.2015	10 hours
District collector office, main road, Cuddalore	20.03.2015	10 hours
Cuddalore port railway station, cuddalore	22.03.2015	10 hours
Near Axis bank, cuddalore	23.03.2015	10 hours

3.2 Intersection turning movement survey

The objective of the survey was to assess the traffic flow and delay characteristics on individual arms at the intersections. The survey was conducted for 16 hours on a normal working day at 3 intersections. The survey locations and the schedule are listed in table 2.

Table 2: Intersection volume count survey locations and schedule

Location	Date	Duration
Intersection at cuddalore by pass near bus stand, cuddalore	19.03.2015	10 hours
Intersection at District collector office main road, cuddalore	20.03.2015	10 hours
Intersection at across cuddalore port railway station,cuddalore	22.03.2015	10 hours
Intersection at near axis bank, cuddalore	23.03.2015	10 hours

3.3 Household travel survey

The objective of household interview survey was to assess the household, socioeconomic and trip characteristics of residents within Cuddalore. The survey was carried out on a sample basis in few households, representing about two percent of households within the study area.

3.4 Speed and delay survey

The objective of this survey was to assess the speed and delay characteristics along the existing road network, identify bottleneck locations and their probable causes.

3.5 Parking survey

The main objective was to appreciate the parking demand and supply characteristics, identify issues and constraints and suggest appropriate policies for meeting the horizon year parking demand (table 3).

Table 3: Parking Survey Locations and Schedule

Location	Date	Duration
On-Street Parking:		
North car street	07.03.2015	6 hours
East car street	07.03.2015	6 hours
South car street	09.03.2015	6 hours
West car street	09.03.2015	6 hours
Off-Street Parking		
Cuddalore Bus Stand	11.03.2015	6 hours
Stand Below by pass flyover	11.03.2015	6 hours

3.6 Pedestrian survey

The objective was to access the pedestrian flows along and across the intersecting arms at important junctions and mid blocks and to suggest improvement measures for safe movement of pedestrians (table 4).

Table 4: Pedestrian survey locations and schedule

Location	Date	Duration
PolytechnicCollege Road, Cuddaiore	12.03.2015	10 hours
M.G Road	12.03.2015	10 hours
G.P. Kohli street	13.03.2015	10 hours
South Car street	13.03.2015	10 hours
West Car street	13.03.2015	10 hours
Silver beach	14.03.2015	10 hours
Auto stand	15.03.2015	10 hours

3.7 Public transport user survey

The objective was to appreciate the public transport user characteristics (origin, destination, mode, trip length and travel cost (table 5).

Table 5: Terminal Survey Locations

Terminal Name	No. of passengers interviewed
Cuddalore Bus stand	220
Cuddalore Railway Stations	180

3.8 Intermediate public transport survey

The survey was conducted at locations with high concentration of Intermediate Public Transport modes and trips. The major locations included are:

- Cuddalore Bus station.
- Cuddalore rail way station
- Flyover starting point (opposite to Mahatma Gandhi's statue)
- Intersection point at south car street and East Car Street (hi front of Axis Bank).

- South car street (opposite of Aasian departmental store)
- West car street (In front of JHV mall)
- In front of engineering main gate (opposite to Rao statue).
- Income tax department office

The need for a traffic control signal at any particular location must, however, be carefully evaluated in relation to several warrants (table 6, 7 and 8).

Table 6: Different sort of warrants

Warrant No.	Phenomenon
1	minimum vehicular volume
2	interruption of continuous traffic
3	minimum pedestrian volume
4	school crossings
5	progressive movement
6	accident experience
7	systems
8	combinations of warrants

Table 7: Minimum Vehicular volume warrant

Number of lanes for moving traffic on each approach		vehicles per hour on major street (Total of both approaches)	vehicles per hour on higher volume minor street approach (one direction only)
Major street	Minor street		
1	1	600	250
2 or more	1	700	250
2 or more	2 or more	700	300
1	2 or more	600	300

Table 8: Minimum vehicular volume for warrant 2

Number of lanes for moving traffic on each approach		vehicles per hour on major street (Total of both approaches)	vehicles per hour on higher volume minor street approach (one direction only)
Major street	Minor street		
1	1	850	175
2 or more	1	1000	175
2 or more	2 or more	1000	200
1	2 or more	850	200

The minimum pedestrian volume warrant is satisfied when, for each of any eight hours of any eight hours of the hours of an average day, the following traffic volume exist.

L On the major street, 600 or more vehicle per hour enter the intersection (total of both approaches) on the major street where there is a raised medium island 4 ft or more in width.

2. During the same eight hours as in paragraph (1) there are 150 or more pedestrians per hour on the highest volume cross walk crossing the major street (table 9)

Table 9: Crosswalk crossing the major street

Vehicles per hour on major street (Total of both approach)		Number of pedestrians on highest volumes crosswalk
With Median	Without Median	
1200	800	350
		350

Critical elements in the location of signal faces are lateral and vertical angle of site toward a signal face as determine by typical driver eye position. The distaance of unobstructed view should vary with the 85 percentile approach speed as shown in table 10 below.

Table 10: Minimum visibility distance for varying approach speed

85 Pencentile speed	Kph	37	40	48	56	64	72	81	89	97
Minimum visibility distance	M	30	53	76	99	122	145	168	191	213

3.9 Vehicle volume count

The advantages of manual methods and situations where these are to be preferred are:

1. The details such as vehicle classification and number of occupants can be easily obtained. With automatic devices these data are unfortunately lacking, and hence automatic counting should be supported by manual counts (table 11 and 12) (figure 1).

Table 11: Road features and counting requirements

Road features and counting requirements	**No. of vehicles per hour that can be counted by one trained observer**
2- lane two way road, with separate observers for each direction; vehicles to be counted and classified	500 vehicles per hour in one direction
2 – Linw two way road, with one observer for both the direction; vehicles to be counted and classified for each direction separately	200 vehicles per hour in both direction
2 – lane two road, with the observer for both directions; vehicles to be simply counted with no requirements for classification and posting into separate direction.	800 vehicles per hour in both direction.

Table 12: Traffic Intersection at Cuddalore by Pass near Bus Stand

Direction of flow	Light motor vehicles and three wheelers	Buses and trucks	Motor cycles and scooters	Animal drawn vehicles	Bicycles	Pedestrian
Turning Left	1834	663	2358	4	784	1536
Proceeding Ahead	4484	4554	7401	9	1146	1792
Down side	3384	3412	4784	14	436	576

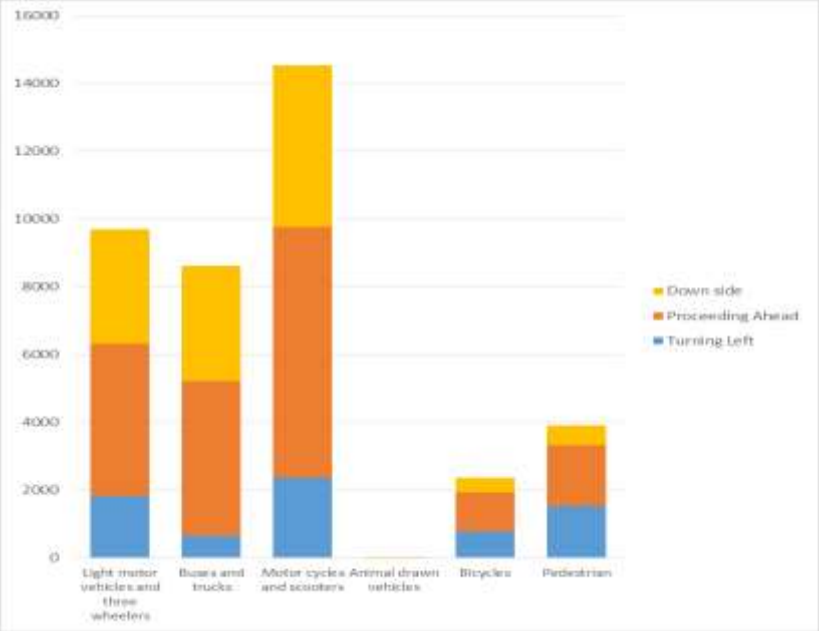

Fig. 1 Traffic intersection at Cuddalore by Pass near bus stand

4. Conclusion

Efficient traffic management on the National Highways, State Highway, Major District Roads and Streets are very essential in Cuddalore. The present Highway system that evolved over the years has a number of deficiencies.

The basic objective of the present study was to identify such management measures that will lead to better traffic performance. We selected as a sample of study in sections of Cuddalore. An attempt was made to understand the problem, reasons and possible solutions for better traffic management.

According to the study, accidents/ breakdown of vehicles, RTO checking and poor driving practices are the most important reasons of traffic jam in Cuddalore. Drowsiness, wrong overtaking and use of alcohol are the major reasons of accidents. Also, it was observed that health of driver; road and vehicle conditions are factors that added to occurrence of accidents [19].

The present Highway system that evolved over the years has a number of deficiencies including low grade sections, narrow and weak pavements, absence of bypasses at congested towns, presence of railway level crossings, and weak and narrow bridges. The cost of removing these deficiencies appears to be very high [20].

The study revealed that the average cost of accidents per annum, on the said section, was as high as about Rs.5 million (cost to the injured party, insurance Company and party causing accidents), including damage to vehicles . As regards high fuel consumption due to traffic jams, the annual loss varied from about Rs.1.2 million to Rs. 1.4 million.

Proper planning and management could reduce the accidents and other hindrances to smooth traffic. In this connection, the paper recommends adoption of a 3-E approach, which includes engineering measures, educational measures and enforcement measures.

Heavy vehicles (trucks and busesjnormally take about 3 hours to generally cover the stretch of 110 kms however, depending on traffic and road condition the actual time spent may rise to anywhere between 3.7 to 5 hours. On an average, it takes 40 to 120 minutes to clear a road jam. However, on an extreme situation, it takes 5 hours to clear the road. Some of the practices adopted by the traffic and traffic controllers not only increase the travel time but also lead accidents and numerous other inconveniences including traffic jams on the road [21].

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