



Traffic Flow Characteristics on Roads of Small Urban Centre

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ABSTRACT

Cities play a vital role in economic growth and prosperity. The sustainable development of cities largely depends upon their physical, social and institutional infrastructure. In this context, the importance of transport infrastructure is paramount. To facilitate this, what is required is a sound urban transport policy. The revolution in the automobile industry and liberalised economy has led to tremendous increase in the vehicle ownership levels. This has resulted in changing traffic characteristics on road network. In this paper it is attempted to analyse the changing traffic composition, trends, speed characteristics and by taking a case study of small urban centre, Nadiad and major traffic corridor in the same city.

Keywords :

1. INTRODUCTION

Almost all the cities of our country are facing the problems of traffic and which is critical. As vehicular traffic began to increase, the congestion on the streets began to obstruct the safe and efficient movement of traffic. Large numbers of accidents were caused, and serious problems of parking and environmental pollution started to be experienced. It was, therefore, needed to give awareness to the operational characteristics of traffic at road transportation and study the need for better geometric design, capacity, intersections, traffic regulations, signals, traffic signs, roadway markings, parking facilities, design of bus stands and street lightings. The increase in income and decrease in vehicle prices resulting into more and more private vehicles on the road network. As a product

the overall traffic growth has been increased appreciably in urban areas all over the world. The present road networks fail to accommodate such growing traffic. Hence congestion imposes various costs on travellers such as reduced speeds, increase travel time, road safety, traffic delays etc. Especially in CBD area due to traffic delay many of motorists fails to give way to pedestrian, and also many pedestrians are crossing roads without care.

2. OBJECTIVES

The objectives of study are to understand various parameters of traffic on selected roads of Nadiad city. The objectives are:

1. Identify location for study of traffic parameters.
2. To obtain traffic volume, speed.
3. To develop speed flow relationships.

3. LITERATURE REVIEW

3.1 TRAFFIC FLOW PARAMETERS [7]

To describe traffic flow, basic parameters are to be studied. The basic parameters used in traffic engineering are speed, Flow, density.

3.1.1 SPEED

Speed is considered as a quality measurement of travel as the drivers and passengers will be concerned more about the speed of the journey than the design aspects of the traffic. It is defined as the rate of motion in distance per unit of time. Mathematically speed or velocity V is given by:

$$v = \frac{d}{t} \quad \dots\dots\dots \text{Eq. (1)}$$

Where,

v = speed of vehicle in m/s

d = distance travelled in m in time t seconds

speed of different vehicles will vary with respect to time and space to represent this variation, several types of speed can be defined:

I) Spot speed

Spot speed is the instantaneous speed of a vehicle at a specified location or section.

II) Running speed

Running speed is the average speed maintained by a vehicle over a particular stretch of road, while the vehicles are in motion, this is obtained by dividing the distance covered by the time during which the vehicle is actually in motion.

III) Overall speed or Journey speed or Travel speed

Travel speed is the effective speed with which a vehicle traverses a particular route between two terminals; this is obtained by dividing the total distance travelled by the total time taken including all delays and stoppages enrooted.

IV) Time mean speed

Time mean speed is defined as the average speed of all the vehicles passing a point on a highway over some specified time period.

V) Space mean speed

Space mean speed is defined as the average speed of all the vehicles occupying a given section of a highway over some specified time period.

3.1.2 FLOW

Practically there are two ways of counting the number of vehicles on a road. One is flow or volume, which is defined as the number of vehicles that pass a point on a highway or a given

lane or direction of highway during a specific time interval. The flow q is expressed in vehicles / hour is given by:

$$q = \frac{n_t}{t} \dots\dots\dots \text{Eq. (2)}$$

Where,
 n_t = no. of vehicles counted

T =no.of vehicles counted passes a particular point in one lane in a defined period t .

The variation of volume with time, i.e. month to month, day to day, hour to hour and within a hour is also as important variation is from hour to hour. The peak hour observed during mornings and evenings of weekdays, which is usually 8 to 10 per cent of total daily flow or 2 to 3 times the average hourly volume.

Generally volume is measured using different ways like manual counting, detector / sensor counting, moving- car objective method etc. volume study mainly established the importance of a particular route with respect to the other routes, the distribution of traffic on road, and the fluctuations in flow. Thus, volume is treated as most important of all the parameters of traffic stream.

3.1.3 DENSITY

Density is defined as the number of vehicles occupying a given length of highway or lane and is generally expressed as vehicles per km. one can photograph a length of road, count the number of vehicles, n_x , in one lane of the road at that point of time and derive the density k as,

$$K = n_x/x \dots \text{Eq. (3)}$$

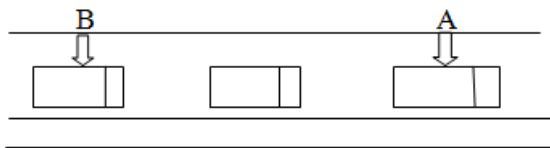


Figure: 1 Illustration of Density
 [Source: Prof.Tom V. Mathew "Fundamental Parameters of Traffic Flow" 2010-01-07]

3.2 RELATION BETWEEN TRAFFIC FLOW PARAMETERS [6]

3.2.1 BASIC MODELS DESCRIBING RELATIONS

The relation between speed and flow can be represented with the help of some curves. They are referred to as the fundamental diagrams of traffic flow.

A. SPEED FLOW RELATION

The relationship between the speed and flow can be shown as follows. The flow is zero either because there is no vehicles or there too many vehicles so that they cannot move at maximum flow, the speed will be in between zero and free flow speed. Speed-Flow relationship is shown in figure 2.

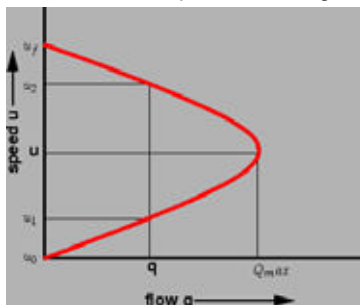


Figure: 2 Speed-flow diagrams
 [Source: Prof.Tom V. Mathew "Fundamental Parameters of Traffic Flow" 2010-01-07]

The maximum flow q_{max} occurs at speed u . It is possible to have two different speeds for a given flow.

4. LEVEL OF SERVICE

The capacity is the maximum possible flow on a roadway or a traffic lane; it is attained at particular optimum speed. The flow increases then speed decreases. When flow reaches capacity, speed starts decreasing, and further creating congestion as shown in fig.3. The six Los is described as given in fig 3.

5.1 Methodology

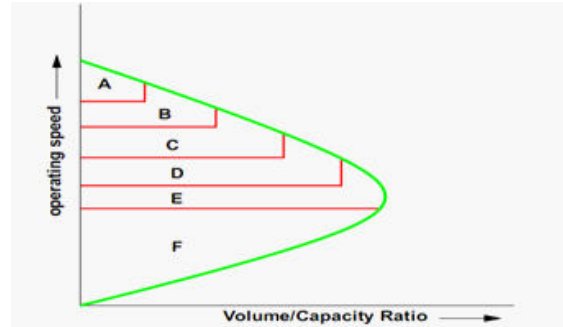


Figure: 3 Level of service A-F
 [Source: Prof.Tom V. Mathew "Fundamental Relations of Traffic Flow" 2009-08-03]

Factors to be considered for the evaluation of level of service of a roadway in a comprehensive manner include the operating speed, travel time, traffic interruptions freedom of manoeuvre, driving comfort, safety, economy, etc

5. STUDY AREA

Though Nadiad city is a small urban area in Kheda district. The increase in traffic is based on increase in population. The increase in traffic is also due to increase in income and absence of public transport. Nadiad junction is also having a connection with two large cities Ahmedabad and Vadodara. Nadiad is administrative centre of Kheda district. The study stretch selected is vaniyavad-santram road.

5.1 Methodology

The data is collected from secondary sources and by primary surveys. The secondary source data are legacy maps, vehicle registration data, and population data. Traffic surveys at the major section of the city were carried out by video recording technique. The methodology is provided in figure 4 below.

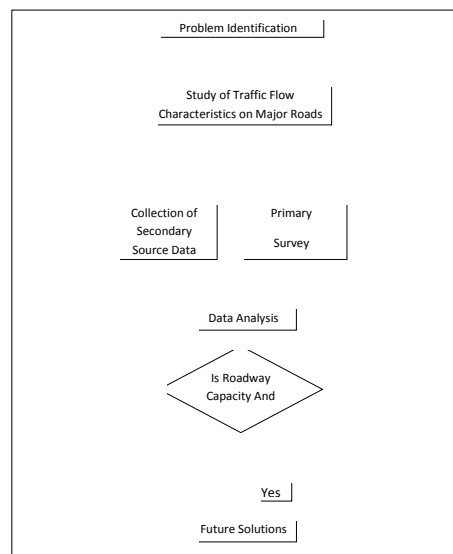


Figure: 4 Study methodology

5.2 Data collection

5.2.1 Collection of Secondary Data

This step includes the collection of data of population and map, from the Nadiad municipality offices.

- Population Data

The decadal growth rate of population is shown in table 1 below. It is increasing by 13.15% from 2001 to 2011.

Table: 1 Population in Nadiad city

NADIAD CITY	TOTAL	
Year	2011	2001
Population	2,18,150	1,92,799
Literates	1,74,931	1,49,766
Children (0-6)	19,994	17,351
Average Literacy (%)	88.28	78
Decadile Growth Rate of Population	13.15%	

- Registered vehicle data

The vehicle registration data collected for 2005-2011 from Nadiad RTO. The vehicle registration data is given in Table 2. The vehicle registration data show increasing trend. Fig 4 shows trend chart. The percentage growth from 2005-2011 is 71.24%.

Table: 2 Yearly Vehicles Registered in RTO Nadiad, Kheda District

Sr. No	Types of vehicles	2005-2006	2006-2007	2007-2008	2008-2009	2009-2010	2010-2011
1	2 wheeler	13005	13989	12297	11540	11988	20329
2	3 wheeler	990	803	1102	1768	2900	4178
3	4 wheeler	1332	1522	1620	1458	2441	3322
4	Bus/Ambulance	11	18	27	12	7	0
5	Tractor	1266	1438	1757	1417	1219	1640
6	LCV	1116	1214	910	765	911	1119
7	Truck/ Tankers	497	796	762	531	676	725
8	other	82	43	58	31	25	22
Total		18299	19823	18533	17522	20167	31335

Table: 3 CLASSIFIED VOLUME COUNT

Time Duration (p.m.)	Two wheeler		Three Wheeler		Four Wheeler		Bus		Tractor		Cycle		Total	Pedestrian	
	up	down	up	down	up	down	up	down	up	down	up	down		up	down
5:00 to 5:15	365	355	228	199	56	46	10	6	2	1	64	71	1403	410	235
5:15 to 5:30	430	423	201	162	54	72	5	6	1	1	76	60	1491	392	196
5:30 to 5:45	464	463	202	204	60	53	7	3	0	1	80	89	1626	385	205
5:45 to 6:00	521	475	210	211	61	52	9	8	2	0	77	81	1707	425	172
6:00 to 6:15	479	517	201	188	63	45	9	11	1	1	75	77	1667	453	185
6:15 to 6:30	456	485	171	189	44	50	4	6	1	2	78	72	1558	387	328
6:30 to 6:45	475	505	151	173	45	66	10	7	1	0	67	75	1575	350	339
6:45 to 7:00	480	460	165	142	37	55	9	8	0	1	70	78	1505	415	188
Sub Total	7353		2997		859		118		15		1190		12532	5065	
PCU Value	0.5		1		1		3		4.5		0.5				
Total PCU	3676.5		2997		859		354		67.5		595		8549		

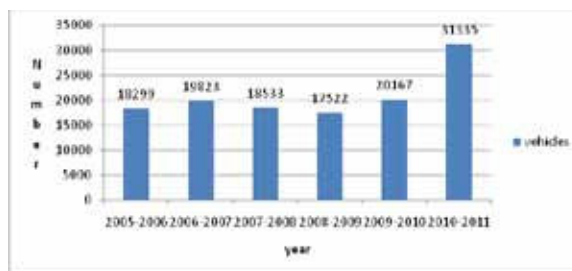


Fig: 4 Trends in vehicle registration in Nadiad RT

- Road Network Data

Nadiad is urban centre. Fig 5 shows Road network. The secondary source data available has been digitized using Transcad software.



Fig: 5 Road Network

5.2.2 Primary Data

- Primary Survey

The primary data were collected by video recording technique during peak hours i.e 5.00-7.00 pm. Traffic volume counts and Spot-speed data were extracted by playing video on computer screen.

5.3 Data analysis

The data is important for decision making. The volume count data and Spot Speed data has been analysed for one section at Nadiad city using Microsoft Excel. From the data of volume count and spot speed study at one section a speed- flow plotting for various modes of vehicles on that section is derived using Regression. Table 3 shows the classified volume count. The composition of traffic volume is given in figure 6 and figure 7. The scatter plots and trendline linear equations with R2 values are given in figure 8 to figure 11 for two wheelers, four wheelers, three wheelers, and bus respectively.

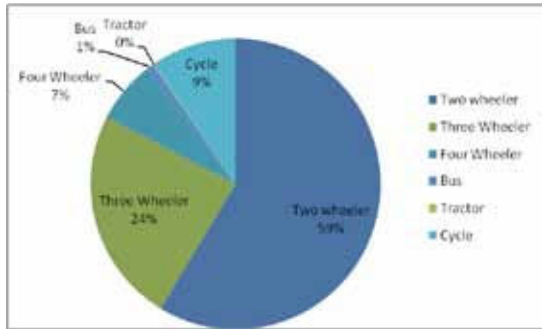


Figure: 6 Composition of traffic in no. of vehicles

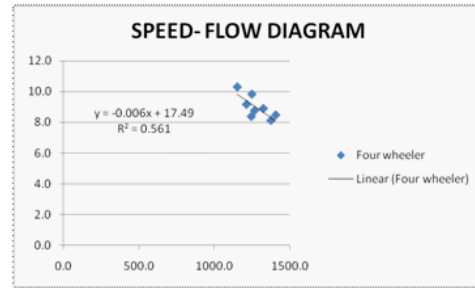


Fig:8 Scatter diagram and Trendline for Four- wheeler

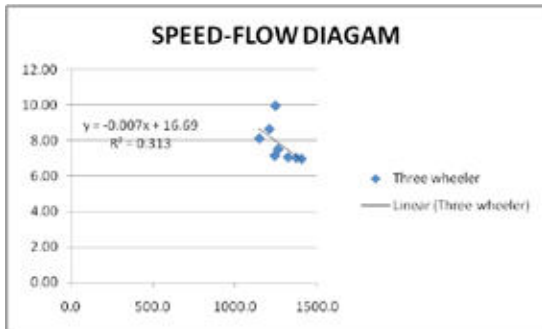


Fig: 9 Scatter diagram and Trendline for Three- wheeler

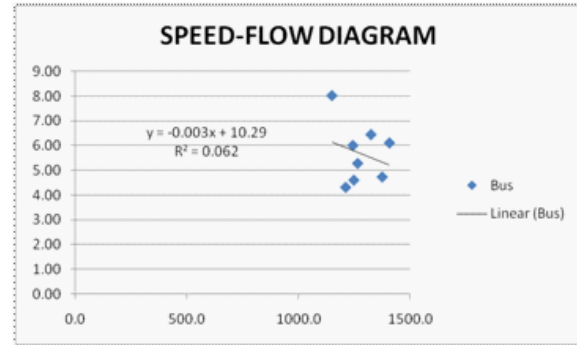


Fig:11 Scatter diagram and Trendline for Bus

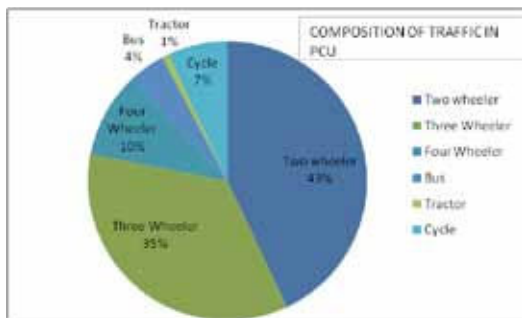


Figure: 7Composition of traffic in PCU

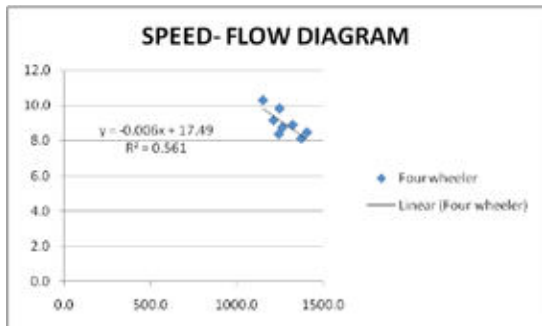


Fig: 10 Scatter diagram and Trendline for Three- wheeler

6.0 Conclusions & Recommendations

The traffic study on selected road in Nadiad city helps in understanding its characteristics.

1. The existing roads are studied by reconnaissance and vaniyavad- santram road selected.
2. Traffic volume on study road is 6266 veh/hr which is 4275 pcu/hr.
3. The average speed of traffic stream is 8.6 km/hr.
4. The traffic composition reveals that the percentage share of mode is 59% Two wheelers, 24% Three wheelers, 7% Four wheelers and 1% Bus.
5. The regression equations and R2 values are as under.

Mode	Regression Equation	R2
1. Four wheeler	$vc = 17.49 - 0.006QT$	0.561
2. Three wheeler	$V3W = 16.69 - 0.007QT$	0.313
3. Two wheeler:	$V2W = 12.91 - 0.000QT$	0.067
4. Bus	$VB = 10.29 - 0.003QT$	0.062

Where, vc = Speed of Car, kmph
 $V3W$ = Speed of Three wheelers, kmph
 $V2W$ = Speed of Two wheelers, kmph
 VB = Speed of Bus, kmph
 QT = Total vehicle flow in veh/hr.

The low R2 value indicates poor relationships.

Recommendations: The study is to be carried out with large sample size and more study locations.

REFERENCES

1) Azeem Uddin, " Traffic congestion in Indian cities: Challenges of a rising power ", Mar 26-28, 2009 Kyoto of the Cities, Naples, ~ 2) C. Jotin Khisty & B.Kent Lall " Transportation Engineering- An Introduction", PHI Publisher- New Delhi- 2002. ~ 3) Chapter 35 "Capacity and Level of service" May 24, 2006, NPTEL ~ 4) Donald R.Drew "Traffic Flow Theory And Control" McGraw-Hill Book Company. ~ 5) Dr.Kadiyali L.R. " Traffic Engineering and Transport Planning" Khanna Publishers. ~ 6) Prof.Tom V. Mathew "Fundamental Relations of Traffic Flow" 2009-08-03. ~ 7) Prof.Tom V. Mathew "Fundamental Parameters of Traffic Flow" 2010-01-07. ~ 8) S.K.Khanna, C.E.G.Justo " Highway Engineering" Nem Chand & Bros, Publishers.