Road traffic accidents: Threatening Surat city

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Abstract:

Road traffic crash deaths are under the radar of major causes of unnatural loss of human lives world over. In year 2004, projections of World Health Organization predicted that the number of people dying in road accidents will acquire third position by 2020 among causes of un-natural deaths worldwide which was by than that of on 8th position. It was reported in India that a total of 1,39,091 persons died on roads during year 2012. Surat is a vibrant city of Gujarat that had been declared as fastest growing during Census of India, 2001 with a rate of 88% after which in 2011 the reported rate was around 65% showing yet growing population with national populous city rank 7. The city has its economic and social magnets that serves as a reason of increasing urbanization. Having increased population (4.46 million in 2011), the demand for transportation has been increased and in absence of effective mass transportation, the citizens opt for personal mode of travelling often. Out of 2 million registered vehicles, MTW share 79% and cars as 10% by year 2013. This paper discusses over pattern and distribution of vehicular growth and road traffic crashes being observed in Surat. On an average, fatal cases shared 19.63% of total accidents in an overall volume of 2500 crash cases in recent past. 62.43% of accidents occur at location of staggered and T intersections of two-lane roads. Almost 60% victims of road fatality belong to the age-group between 25-44 years who are the economy contributors for the city and the country as well. Major reason thereof being effective law enforcement due to limitation of government staff with addition from lack in public awareness and road discipline. It was also observed that the City Development Plan has no inclusion of strategies to reduce road accidents and fatalities though deaths of bread-winners of families causing large economic and social losses. Overall, the road traffic accidents in Surat are alarmingly becoming threat for the development and must be addressed to reduce. The paper also trends the accident severity index, vehicle-accident proportionality index, vehicle involvement, occurrence nature of accidents, ages of victims and locational distribution of crashes.

Keyword: *Fatality, Road accident analysis, Surat, Road crashes, Severity index,*

Introduction:

Road crashes or traffic crashes have been defined as a collision occurring on a public road and involving at least one moving vehicle. Among all types of accidents, those caused by motor vehicles claim the largest toll of life and tend to be most serious. The World Health Organization (WHO) estimates that, each year, almost 1.2 million people die in road crashes worldwide and as many as 50 million are injured or disabled. WHO projects that fatality occurring due to road crashes will attain 3rd top ranking by 2020 from 9th ranking in the year 2003.

In India, the incidences of accidental deaths have shown a mixed trend during the decade 2002-2012 with an increase of over 51.85 percent in the year 2012. A total of 3,94,982 accidental deaths were reported in the country during 2012 (4,098 more than such deaths reported in 2011) showing an increase of 1.05 percent as compared to previous year. A total of 1,39,091 persons were killed in road accidents with 37.4% share in un-natural total deaths. Road accidents share 35.2% over various causes of accidental deaths during 2012. For the same year, Gujarat State was sharing 6.3% among accidental deaths in major states whereas road accidents in the state shared 9.20% for a total 1,23,402 Km length of surface roads[2].

Surat emerged as the fastest growing city with a decadal growth rate of 83.34% in the Census of India, 2011. Moreover, it is the second largest metropolitan of the state accommodating more than 44.62 Lacs population and 8th largest city of the country. Surat city had an area of 325.26 Sq Km in the year 2011. In March 2013, total length of roads were reported as 2541.44 Km. In the city, 87% roads are surfaced either with bitumen or with concrete. Out of 13% un-surfaced roads, 5% roads permit motorized traffic and 8% of total roads do not permit any vehicular movements.

The city is having a variety in road network consisting of arterial roads larger than 60 Mt width, sub-arterial roads, collector streets and residential streets showing a wide variation in size. Surat city roads are installed with 149 traffic islands and 61 traffic signals as traffic management measures. Moreover, 158 Km of roads are with dividers / central medians which also assist in traffic management. Under the PPP mode, Surat Municipal Corporation has taken initiatives and provided opportunity for the private organizations to sponsor traffic islands to construct and maintain fountains and other urban beautification elements.

Most of roads in Surat seem considerably encroached upon through parked vehicles, hawkers and road side business activities. This results not only in restricting the traffic flow, but also putting the road users' life at great risk. This paper attempts to analyse the road accidents in Surat and distribution of accident types for the year 2012. A hidden epidemic is taking place each year and threatening the city.

The remainder of the paper is organized in a way that discussed an overview of city demography and vehicular population, vehicle growth, road inventory followed by road accidents and analyses followed by Severity index and vehicle accident proportionality index and finally the provisions of Development Plan of Surat with concluding remarks.

Demographics and vehicle growth

Due to rapid industrialization, with the large establishments of KRIBHCO, L & T, ESSAR, NTPC, Reliance industries etc. and in addition, the traditional textile industries, diamond industries and construction activities has made Surat an important growth magnet for the state. Also relatively peaceful and harmonious social environment and moderate climate has attracted the migrants to become permanent settlers in the city. This resulted in higher decadal growth compared to any city in the state in last two decades. Table 1 show the population of Surat city wherein it is observed that the centurial increase in city area is about 40 times, coupled with about 37 times increase in the population. Data shows the abrupt rise in the decadal population after 1981 highlighting effect of substantial in-migration making the city population grow.

Table 1 Demography for Surat

Year	Area (Sq Km)	Population (Lacs)	Density (ppHa)	Sex Ratio
1901	8.18	1.19	145.85	953
1911	8.18	1.14	140.42	926
1921	8.18	1.17	143.56	902
1931	8.18	0.98	120.94	868
1941	8.18	1.71	209.58	898
1951	8.18	2.23	272.83	916
1961	8.18	2.88	352.11	915
1971	33.85	4.71	139.33	887
1981	55.56	7.76	139.77	857
1991	111.16	14.98	134.83	839
2001	112.28	24.33	216.76	777
2011	325.26	44.62	137	758

(Source: Surat Municipal Corporation, 2013)

Surat city has seen an unprecedented growth in last four decades recording the latest as the highest growth rate in the country and a sudden population rise. The city now ranks the 8th largest city in the country. Coupled with this, the spill over of population into periphery has also been observed. The jurisdictional limits of the Surat Municipal Corporation (SMC) have also been extended regularly to include the outgrowth. There are about 6.50 Lacs of persons (2001) residing in the immediate periphery of the city. Yet, with the growth in population sex-ratio figures are continuously falling which is not a sign of healthy social progress and indicator of male predomination in population with a possibility of large male workers receding in the city.

In the last decade, vehicular population has been observed to have rapid growth rate due to quantum and spread of activities concentrated in city. The socio-economic development and inadequate mass transport system have led to the growth of the vehicle

population in Surat is high. Increase in vehicle volume on road is a matter of worry for efficient traffic management.

Table 2 Decadal vehicular population

Year	Total Vehicles	MTW		Cars	
		Nos.	%	Nos.	%
2003	8,96,844	7,12,928	79.50	77,239	8.61
2004	9,82,713	7,81,775	79.55	85,638	8.71
2005	10,89,689	8,68,476	79.70	95,465	8.76
2006	12,11,150	9,64,843	79.70	1,08,334	8.94
2007	13,35,125	10,62,949	79.61	121862	9.13
2008	14,37,885	11,41,942	79.42	135864	9.45
2009	15,16,258	11,99,656	79.12	147576	9.73
2010	16,14,340	12,70,400	78.69	163532	10.13
2011	17,52,118	13,70,899	78.24	187377	10.69
2012	19,22,382	14,95,610	77.80	218615	11.37
2013	20,81,716	16,16,361	77.65	244980	11.77
	132.11%	**126.72 %**	**79 (Avg.)**	**217.17 %**	**9.75 (Avg.)**

(Source: R. T. O. Surat, 2013)

In 2003, total of the vehicles were nearly 8.96 Lacs rising to nearly 20.82 Lacs in 2013. This shows an increase of 132.11 % in Table 2. The category wise data shows that number of motorized two wheelers (MTW) and motorcars have increased by 126.72% and 217.17% respectively in this decade. Alarming growth rate of vehicles emerge a need for better road network with safe driving conditions. Also, such rise in MTW and car show present of ineffective mass transportation facility for trips of various purposes.

A very typical composition of vehicle population exists in Surat city. Out of all vehicles being registered each year the major vehicles are two wheelers (almost 80%), cars and three wheelers (Auto rickshaws) with a decadal average share of 79%, 9.75% and 4.56% respectively, sum of which is 93.31% showing presence of considerable use of private mode.

Road inventory

Recent attempts to improve traffic management on the city roads have resulted in widening of almost all major corridors of the city. Roads had a city land-use share of 9.96 Sq Km by the year 1995-96, from which it was reported to be 28.29 sq km in year 2006, having about 25 % of the SMC area (i.e. 112 Sq Km). So far, 80 percent of the area of the city was connected through a total Road length of 1233.046 Km by end of year 2006 and has reached a total of 2541.442 km in year 2013.

Of the Road network, 87% roads of Surat city are well surfaced and the rest is un-surfaced (Fig. 1). 5% roads are surfaced with cement concrete which is a costly affair as

well; such a road reduces operation costs of vehicles higher speeds may be permitted on such roads but not at the cost of safety of Vulnerable Road Users (VRUs).

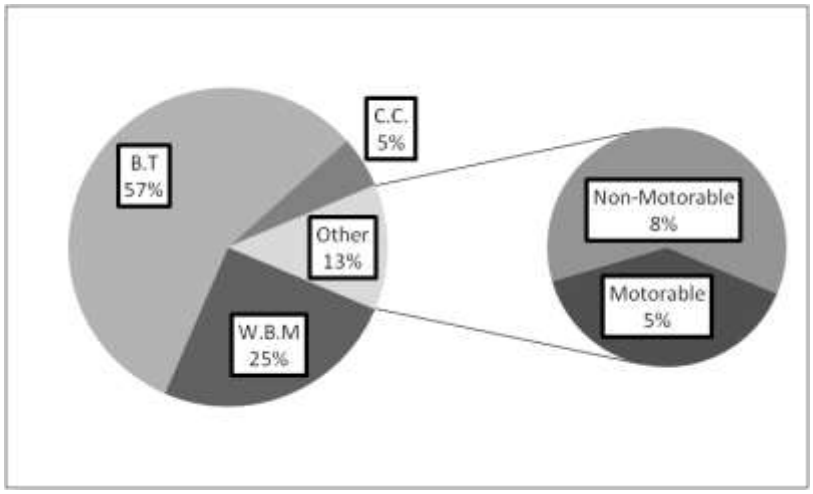

Figure 1 Roads length distribution

There is a total of 149 intersections in the city that have traffic islands. Of these, 42 have traffic islands or channelizes which are sponsored through PPP. 115 islands are already constructed till 2010 and 34 islands were added by the year 2013. Considering the rapid growth of vehicles, coupled with the poor public transport system, SMC along with the Surat Traffic Police has taken up a number of traffic management initiatives during the past decade. Road dividers of about 158.0 km length were added to the existing 122.46 km length in this duration. Also, Traffic signals were installed at 61. Following table provide inventory of traffic in Surat.

Table 3 TRAFFIC JUNCTION INVENTORY

Junctions	**Till 1994**	**1995-2005**	**Total**
Traffic Islands	115	34	149
Traffic signals	61	-*	61
Dividers (Km)	122.46	35.54	158

(Source: SMC, 2013) * The Nos. are not disclosed by SMC due to tendering process

In various zones, SMC has initiated traffic management through sponsorships through PPP. The contributing organizations sponsor a particular traffic island or channelizers to maintain it throughout the year. Various organizations sponsor landscapes and traffic awareness for the people welfare, though these organizations get space for their own commercials too. Table 5 narrates detail of such sponsored traffic islands in different zones.

Table 4 Traffic management inventory

SMC Zone	No. of Traffic Islands and Channelizers (Sponsored)
Central	6
North	6
East	6
West	10
South	3
South-East	1
South-West	10
Total	**42**

(Source: Surat City Development Plan, 2006-12)

Road traffic accidents in Surat

Year-wise record of road accidents was observed for Surat towards occurrence of Fatality (F), Grievous Injury (GI) and Minor Injury (MI) cases. There was some Non-injury (NI) accidents also recorded resulting in property losses only. Fig. 2 show trend observed for the road traffic accidents occurred on roads of Surat city.

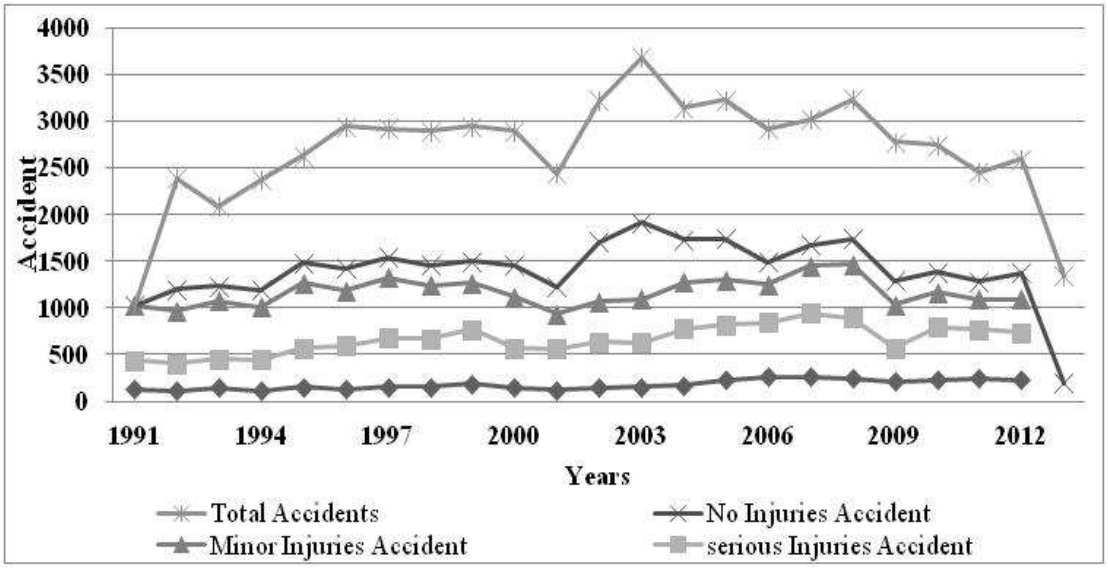

Figure 2 Road traffic crashes pattern

(Source: Surat City Traffic Police, 2012)

Till the year 1991, it was reported that each year approximately 1345 accidents are occurring on roads of Surat. Based on these, the distribution of accidents is shown in Fig. 3. This diagram represents the percentage share in degree of brutality of road traffic accident type. 20% accidents are fatal which led people to death and in 38% accidents

victims have to accept major injuries or disabilities where as 25% accidents with comparatively less injuries.

Figure 3 Share of accident type

Accident Severity Index

The accident severity index measures the seriousness of the accident and the availability of medical facilities in the city. Fig. 4 signifies accident severity index of Surat city which shows that the number of deaths per 100 accidents. For Surat this index ranging around 20 since last decade. The values indicate that medical facilities are available (for post-crash stage) within the reach from accident spots. This aspect indirectly indicates that the health related infrastructure and facilities are at good level. It can be well observed that though the rate is low yet it is increasing significantly.

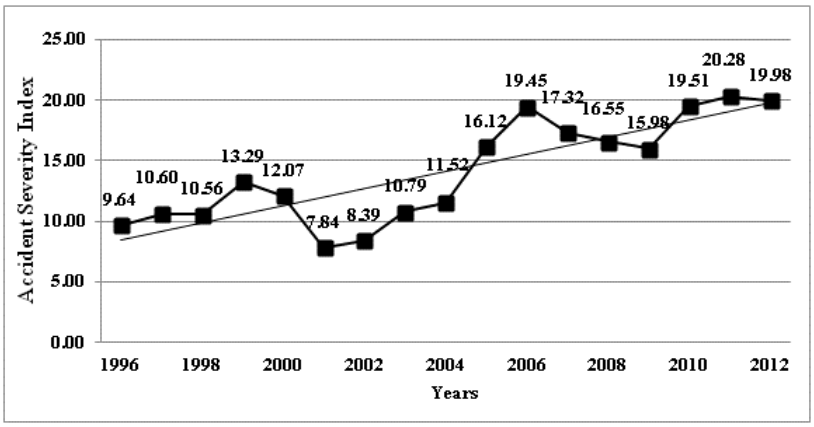

Figure 4 Accident severity index for Surat

It shall be noted here that the accident severity index is lower for the years 2001, 2002, 2008 and 2009 in which maximum accidents occurred during the decade (Refer Fig. 2). This may be the result of prompt post-crash services and availability of good medical facilities.

Traffic police of Surat may not be able to record all the minor accidents occurring on the roads of the city and this might have led to little increase in the accident severity index over past a few years. Recently introduced city-wide emergency ambulance service with basic medical facilities (Also known as 108) may have significant impact since the service was initiated in year 2007 at free if cost to citizens.

Vehicle-Accident Proportionality Index

The Vehicle-accident proportionality index the availability of the vehicles population in City and the total number of the accident. Figure 5 signifies Vehicle-accident proportionality index of Surat city which shows that the number of vehicles per accident. This index show proportional increase of accidents vehicles population and accident both are increased.

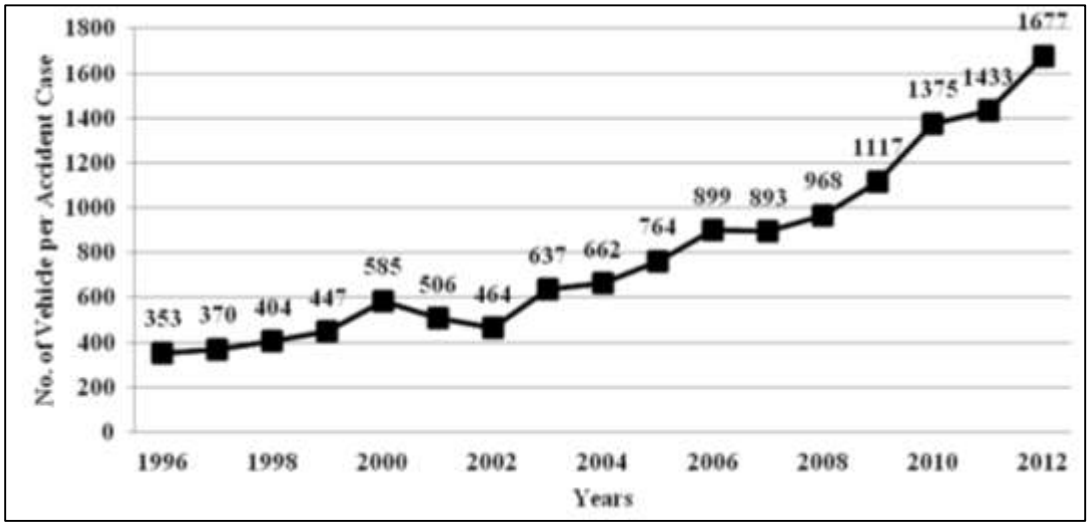

Figure 5 Vehicle-accidents proportionality index

It shall be noted here that the vehicle involvement in accident index is lower for the years 2001, 2002 and 2007 in which maximum accident reported during the decade (refer Fig. 2.)

Vehicle-wise Accident Rates

Table 6 accounts the number of accidents by involvement of various types of vehicles during the year 2012. Each year vehicle population is increasing where MTW share almost 79%; it is obvious that MTW share may be higher (almost 28%) in accidents also.

Table 5 Vehicle involvements in road accidents (year 2012)

Type of vehicle primarily responsible	**Number of Accidents**				
	F (%)	**GI (%)**	**MI (%)**	**NI (%)**	**Total no.**
MTW	12.7	41.2	30.8	15.3	308
Moped	50.0	37.5	12.5	0.0	32
Auto rickshaw	16.3	45.7	23.3	14.7	129
Motor car	10.7	40.8	29.1	19.4	289
Jeep	0.0	50.0	35.7	14.3	14
Taxi/cab	0.0	42.9	57.1	0.0	7
Bus	23.5	17.6	26.5	32.4	34
Truck	32.6	32.6	14.0	20.9	129
Tempo	25.6	35.6	23.3	15.6	90
Articulated vehicle	31.8	18.2	9.1	40.9	22
Tractor	41.7	50.0	8.3	0.0	12
Other vehicle	51.9	26.9	9.6	11.5	52

(Source: The Traffic Police department, Surat 2012)

Accidents by Nature of Occurrence

Table 7 point out different type of accidents that occur during the year 2012. The accidents are categorized in few most occurring types. In Surat city, mostly observed type of road accident is of head on collision, rear end collision and overturning type in nature.

Table 6 Accidents by nature of occurrence (year 2012)

Nature of Accident	Person Killed	Number of Accidents				
		F (%)	GI (%)	MI (%)	NI (%)	Total No.
Over-turning	**25**	**14.8**	**40.6**	**27.1**	**17.4**	**155**
Head on collision	**66**	**23.9**	**42.6**	**23.2**	**10.3**	**272**
Rear end collision	**39**	**16.2**	**36.5**	**30.7**	**16.6**	**241**
Collision brush	1	1.3	15.2	24.1	59.5	79
Right angled collision	17	21.3	38.8	25.0	15.0	80
Skidding	6	21.4	42.9	17.9	17.9	28
Right turn collision	10	22.2	40.0	26.7	11.1	45
Hit & run	41	31.5	37.7	12.3	18.5	130
Others	24	19.8	41.4	31.0	7.8	116

(Source: The Traffic Police, Surat, 2012)

Major proportion of head on collision indicates that the roads which are prone to accidents are not segregated for different direction of traffic movement. With well-developed urban roads, a large portion of head on collision cases indirectly show lacuna

in public awareness for driving sense and discipline as well. 23.73% fatality and similar proportion of injuries were observed in head on collision cases. Rear end collision share in fatality was detected as 20% and it had a largest fatality in share such occurrence. Here, other type of accidents share a major portion of the total occurrence and information in the dead is unavailable thus reason, involvement of vehicles, pedestrians and if details of such incidence get worked out, the analysis of accidents may be derive with some prompt results. Such an analysis may be helpful for future planning of better traffic management.

Age-wise Distribution of Accident Victims

This data show that the child fatality is relatively low in Surat city. The adult work age group (18-54 years of age) account for more than 70 % of all causality. The data distribution is reconstructed by age group in three majors as age up to 18 years, 18-54 years and above 54 years of age; Fig. 6 shows the percentage shared by each group.

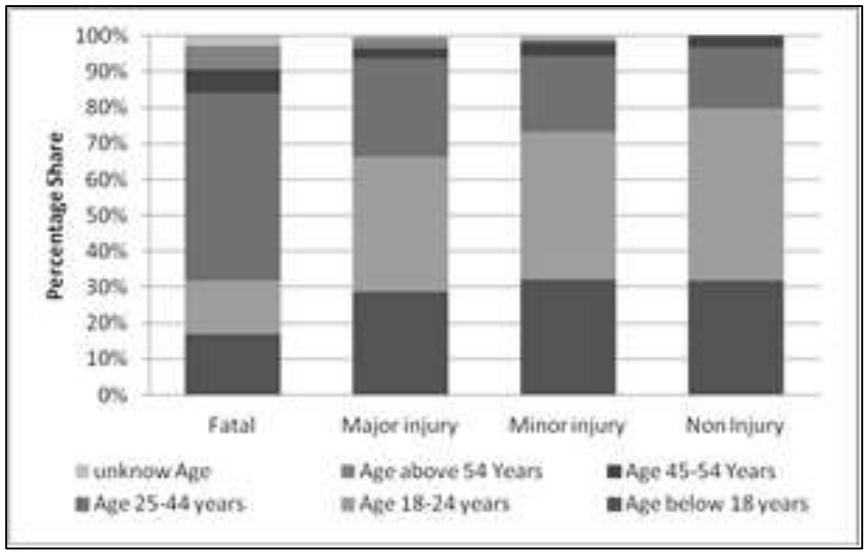

Figure 6 Accident distributions by victim age (year 2010)
(Source: The Traffic Police department, Surat)

In all the accident cases, it was observed that the major percentage share is from persons belonging to an age group of 18-54 years. It shows that the effect of all these accidents is on economically active cohort of the city.

Location based Accident Distribution

Table 8 stands for accident distribution with respect to location of its occurrence. It is to note that, as per records made available by The Traffic Police, Surat; it is that during year 2012, only the 477 road accidents occurred have identified as to be taking place at

location of intersection only. There is not even a single event mentioned which had occurred on mid-block section of road though accidents have been classified according to the type of road which is discussed in following section here.

Table 7 Accidents on junctions – year 2012 *

Junction Type	No. of the Accidents	Fatality (%)	Injury (%)
T-intersection	**161**	**19.9**	**60.9**
Y-intersection	62	17.7	75.8
Four arm intersection	50	24.0	70.0
Staggered intersection	**143**	**9.8**	**62.2**
intersection with more than four arms	15	13.3	93.3
Round about intersection	44	31.8	65.9
Manned rail crossing	2	100.0	0.0

(Source: The Traffic Police, Surat, 2012)

* NOTE: only 477 accident details are covered in Table 8 due to pending compilation.

Here, it is important to note that the major of accident occurrence, fatality and injuries took place on T intersection and staggered intersection, yet these junctions are signalized or controlled manually, details are not available. Almost 65% of accidents were occurred on such intersection with a share of about $1/1.5^{th}$ of the total fatality. For better investigation and analysis yet better data collection practice shall be in force.

Table 8 Location based distribution – year 2012

Carriageway	Accidents	Fatality	Injury
Single lane	279	54	229
Two lanes	716	151	527
Three lanes or more with median	81	8	62
Four lanes or more with median	70	16	49

(Source: The Traffic Police, Surat)

Table 9 presents accident distribution as of its occurrence on type of road carriage way. It is to observe that the major proportion of accident is accumulated on carriage way with two lanes. Generally, such carriage ways do not permit movement of vehicles with higher speed, questionably higher rate of accidents are observed.

Development plan considerations

Surat is an important commercial hub for the region. A number of diamond and textile industries around 52,059 in Surat are established in the city and these industries supply goods around the world. As of today, the city is progressing very fast in each development aspects. The City Development Plan already has been published. It was

observed that road traffic accidents were nowhere mentioned. Also, measures to reduce the road traffic accidents shall be worked out and enforce with the help of law.

Conclusion

Surat is emerging as a mega city showing high values of growth rate and spatial expansions. It has become a hub for variety of industries and commercial activities. Vehicular population is increasing largely with major proportion of two-wheelers (almost 80%) which are a part of vulnerable road users. With a rate of accidents occurring on roads, it seems that there is considerable lacking of enforcement of effective traffic management. Also in this regards, major of the accident cases are of 'Head on collision' nature showing a lacuna in public awareness. Almost 61% of accidents were reported on two lane road at staggered intersection. This show a need to have prompt attention which can be furnished by providing signs and markings on local two lane roads resulting in educating people to some extent and reduction in accident occurrence. The revision of Development Plan which is already in progress shall identify Road Traffic Accidents as one of the key component and incorporate provisions for accident reduction mechanisms as the epidemic which is taking place on city roads may have large social and financial impact.

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