CHAPTER 5

ACCIDENT CAUSATIVE FACTORS

5.1 BACKGROUND

Vehicle density in the roads of our major cities continue to show an upward trend. In recent years different types of vehicles have come into operation. Unfortunately, this has not been matched with expansion of road facilities to accommodate them. Road user behaviour has undergone changes leading to a scene where more and more road users violate traffic rules. Enforcement of traffic discipline has become a difficult task.

5.2 FACTORS INFLUENCING ACCIDENT SCENES

Road accidents do not just happen but are caused. Thus if accidents are caused by some agents, surely they could be identified and appropriate remedial measures developed and implemented for their prevention to the extent feasible. There are however, number of factors which contribute directly or indirectly for occurrence of the accidents - road, vehicle, driver, road user other than the driver, and the traffic environment [Kadiyali, 1987a].

5.2.1 Traffic Volume

Investigations on two-lane rural roads have shown that the accident rate increases with volume up to about 7,000 vehicles per day and then decreases with further increases in volume. The comparison of results obtained from Kenya and Jamaica with those from developed countries has shown that at a flow level of 100 vehicles per hour, the accident rate in Kenya was over three times greater than in developed countries and the rate in Jamaica was almost five times greater. This was attributed to other factors involved such as road user behaviour and vehicle condition and maintenance [Jacobs, 1976; Srinivasan, 1991b]. The number of accidents, other conditions being equal, depends on the volume or intensity of traffic, which determines the speed of vehicles, law of motion of traffic streams and the emotional stress of drivers. An analysis of statistical data of different countries makes it possible to draw conclusions to show how the volume of traffic affects the number of accidents. The number of accidents grow comparatively slowly in proportion to the traffic volume.
corresponding to normal level of service [equal to half the traffic capacity of road]; a further growth in volume is attended by a sharp increase in the number of accidents. The broader is the range of speed in traffic stream, the greater is the number of accidents. For this reason the number of accidents is appreciably greater with mixed traffic than with homogenous traffic.

5.2.2 Public Transport

Buses are extensively used for travel in Indian Cities. However, in comparison with the western countries and even with other developing countries, the bus ownership levels are very low. The buses per 1,000 population in cities of U.K. is 0.84, compared to 0.52 in Rest of Europe, 0.36 in North America, 0.48 in Asia, 0.30 in Africa. The same is 0.17 in Indian Cities with 2 to 1 million population compared to 0.24 in cities with 1 to 3 million population and 0.35 in cities with above 3 million population [Srinivasan, 1991]. The figures of buses in Indian cities with over 3 million population [i.e. Calcutta, Bombay, Delhi and Madras] are comparable with that of North America. But taken together with automobiles, the number of buses in North American cities is offset by 350 cars for the same population, whereas for the largest Indian cities, the comparable number is just 20 [Srinivasan, 1991a]. Since the bulk of the population in India is in the low income group which cannot fund to have their own transport, emphasis has to be given to the provision of public transport. When road space requirements per person movement is considered, buses and public transport systems are found to be efficient [Table 5.1].

Table 5.1 Space Requirements for Various Modes

<table>
<thead>
<tr>
<th>Mode</th>
<th>Average Speed in Kmph *</th>
<th>Occupancy</th>
<th>Area Required Per Person in Sq.m</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pedestrian</td>
<td>4.7</td>
<td>1.0</td>
<td>0.7</td>
</tr>
<tr>
<td>2. Bicycle</td>
<td>12.0</td>
<td>1.0</td>
<td>8.0</td>
</tr>
<tr>
<td>3. Motor cycle</td>
<td>12.0</td>
<td>1.1</td>
<td>17.5</td>
</tr>
<tr>
<td>4. Car</td>
<td>40.0</td>
<td>1.5</td>
<td>47.0</td>
</tr>
<tr>
<td>5. Bus</td>
<td>10.0</td>
<td>40.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Source: Kurt Leibbrand, 1970.

* Kmph - kilometre per hour

The main complaint of the bus drivers is against cyclists, pedestrians and hand drawn and bullock carts as impediments for safe driving. Interference of other modes, while
parking and moving causes inconvenience to drivers of buses which is also contributing to occurrence of accidents. In Madras City buses share 45.53 per cent of total trips and trend is to encourage public transport systems in cities.

5.2.3 Taxis, Autorickshaws, Vans and Cars

Quite often the drivers of taxis do not respect 'Halt and Go' or 'No Parking' or 'Traffic Signals'. Mostly, the taxis are not parked in organized taxi stands. The taxis and autorickshaws without passengers move slowly on the road, with drivers scanning the road for potential passengers. With passengers in, they are the fastest with less respect for traffic rules. It is a common sight to see an autorickshaw or a taxi going on the extreme right lane and turning sharply to turn left in a road. Similarly they cut in diagonal while turning right into a street without adhering to the rules. They take quick sharp turns to left or right without looking at the vehicles coming at the rear. In Madras, even though, the share of this group accounts for meeting 1.87 per cent of the total trips, it is one of the important modes contributing towards occurrence of accidents. Per capita rate of car ownership in the cities of U.K. is 0.23 compared to 0.20 in rest of Europe, 0.3 in North America, 0.02 in Asia, 0.03 in Africa. The same is 0.01 in Indian cities with 1 to 3 million population compared to 0.02 in cities with above 3 million population [Srinivasan, 1991]. Generally cars, either owner driven or by paid drivers, they obey the traffic rules. Autorickshaw being a smaller vehicle the driver is able to find his way in the traffic as he wishes.

5.2.4 Two wheelers

The two wheelers are the most susceptible to accidents as the riders come in direct contact with other vehicles or surfaces in case of an accident, since there is no protective shield around the driver. The two wheelers cause hindrance to the fast moving vehicles, since they try to occupy whatever space available in between other vehicles. On a distance travelled basis, a motor cycle is 17.7 times more likely to be involved in an accident than a car and the rider is 16 times more likely to become a road accident casualty than occupants of a car [Motor India, 1983]. The lane shifting habit is a dangerous practice resorted to by the drivers of two wheelers. In Madras City two wheelers share 10.70 of total trips.

5.2.5 Trucks

The total traffic handled by Madras Port Trust has increased from 2.5 million tons in 1956 to 24.5 million tons in 1990 [Govindaraj, 1992]. Urban goods movement include delivery of raw materials, food, water, fuel, waste products, semi finished and finished
components and household items [Daniel and Warnes, 1983]. The truck movement is influenced by land use, population, industrial growth etc. Normally trucks move at very high speeds, being used for commercial purpose, where time factor counts very much. They neither keep to the lanes on city roads nor resort to cautious driving when negotiating road bends or overtaking other vehicles. The truck drivers are scared about cyclists, who crisscross the roads, forcing them to suddenly alter their direction of driving. Of course among them there are owner driven trucks which are well maintained and driven cautiously.

5.2.6 Bicycles

In Delhi, the bicycle trips account for 28 per cent of total passenger trips [Jain, 1980] and in Madras the cycle trips constitute 10.70 per cent of total trips in 1984. Space required for movement of a person by bicycle is only 8 sq. m compared to 17.5 sq. m by motor cycle and 47 sq. m by car [Kurt Leibbrand, 1970]. The bicycle as a transportation mode is competitive with motor vehicles for relatively shorter distances. The types of trips attracted to the bicycle mode are primarily those of personal transport with limited attraction for trips that involve the transporting of goods. More than thirty per cent of population of Madras City live in slums and another thirty per cent of population is of economically weaker section. These people, because of their economic compulsion, can maintain only a cheap mode of transport, namely bicycle for their mobility. The real danger to the cyclists is when motorists turn left cutting the path of cyclists or when in traffic the cyclists are made to cross the path of the motorists from the cyclists' path. Cyclists also have tendency to turn sharply in a diagonal to the right when turning right into another street or road. The cyclists are expected to be careful if only for their own safety, but the fact remains that they are most careless lot. The developed countries do not have this particular problem in view of the auto dominant nature of traffic. The hazards in this connection arise also due to the fact that both the bicycles and the fast moving automobiles have to use the same carriage way together. So the best solution would be the segregation of bicycles by the introduction of separate bicycle-tracks on both sides of the carriage way, where ever spaces available. If the bicycle-tracks are to function effectively their surface should be good, attractive and adequate. In a related survey by the urban planning experts, 70 per cent of the cyclists surveyed felt that separate well designed cycle tracks would give them a sense of safety [Charted Institute of Transport, 1987]. Bicycle tracks will be justified where the peak hour cycle traffic is 400 or more on routes with a vehicular traffic of 100-200 vehicles per hour. Where the motor vehicles traffic is more than 200 vehicles per hour, separate cycle tracks are justified, even if the cycle traffic is only 100 per hour [Indian Roads Congress, 1977].
5.2.7 Tricycles, Push-Carts and Animal Drawn Vehicles

Their low speed and relatively higher space requirements for movement restricts the movement of fast moving vehicles sharing the same carriageway. Very often these vehicles are overloaded and are sources of risk not only to the concerned drivers, but also to the pedestrians. They may also create high conflict situations among other road users.

5.2.8 Pedestrians

The problems of traffic safety in a developing country happen to be quite different from those met within developed countries. For some more time to come, whether we like it or not, we may live with the phenomenon of pedestrian predominance in urban centres of developing countries. So pedestrian has to be given a walk-way of his own and its should be sufficiently wide for walking purposes. If less space is provided pedestrian tend to drift in to the carriageway itself. If more space is provided hawkers start encroaching. Concentrated pedestrian movement occurs in and near transit terminals, high-rise buildings, departmental stores, theatres, stadia, and other major traffic generators. When the facilities for the movement of pedestrians are restricted, pedestrians tend to spill over to the carriageway along and across the roads inviting accidents. Pedestrian traffic has been found to be influenced by psychological, physiological, social and environmental factors [Abishai Polus, 1986]. Planning and implementing pedestrian facilities require an understanding of the characteristics of pedestrian traffic. Planners tend to concentrate on providing facilities to vehicles rather than to the pedestrians who constitute an important group. In Madras, 28.07 per cent of total trips are performed by walk, which is second highest when compared to share of trips by different modes, the first being bus among all modes. The pedestrians are to be provided with sidewalks parallel with the carriageway and crosswalks at intervals for crossing the carriageway. The capacity and effective usage of sidewalks are often reduced by erection of service facilities, street furniture, encroachment by hawkers, and extension of shops. Some of the service facilities like mailboxes, litter cans, sign posts, light posts, signal posts though necessary will definitely hamper pedestrian movement [Highway Capacity Manual, 1985]. Studying the utility of subways it was observed that the pedestrian violation varied from 2 to 57 per cent among various pedestrian subway locations in Madras [Loga Vinayagam and Ram Das, 1982].

5.2.9 Changes in Width of Carriageway

The existing system of roads in urban area have many limitations in geometric features, which affect the free flow of traffic, besides resulting in accidents. The
width of many roads are not only inadequate but also differ in widths at different locations in any given road section, creating bottlenecks at these points. Traffic safety is affected due to sudden changes in width of carriageway. Wherever there are changes in the carriageway width, for ensuring safe transition to less number of lanes, the minimum taper should be 1 in 15 to 1 in 20, though in some countries like U.S.A., the recommended safe taper is 1 in 50 to 1 in 100 [Srinivasan, 1991b]. Anna Salai, the major arterial of the City of Madras, for example, undergoes changes in width at number of locations. Accident studies show a relationship between lane width and accident rates and it has been found that accidents on rural two-lane roads can be reduced by as much as 20 to 40 per cent if lane widths are increased from 2.7 to 3.3 metres [Srinivasan, 1991b]. A study made has shown that road environment directly and in combination with other factors contribute 28 per cent of accidents [Sabey and Taylor, 1980]. By widening road from 5.5 metres to 6.7 metres the reduction in accident rate has been 21.5 per cent for low traffic volume and 46.6 per cent for higher volumes [Cope, 1955].

5.2.10 Median Barrier

In the arterials of Madras it is seen that due to various modes sharing the space, operating at different speeds, vehicles try to overtake without following traffic rules. Many accidents have occurred due to vehicles going on to the one side leading to head-on collision of vehicles. Median barrier is needed to separate opposing traffic streams, to prevent indiscriminate crossing of pedestrians across the carriageway, and to prevent indiscriminate U-turns and right turns. A study in Madras brings out that if median barriers are provided continuously except at designated crossings, illegal traffic movements by pedestrian and vehicles could be successfully prevented [Jens Abraham, 1986]. On high speed roads with two or more lanes in each direction, the medians improve safety. They help physically to separate the opposing traffic streams, reduce headlight glare and positive delineation of the right edge of the carriageway. Hence it has become practice to have median barriers at the middle of roads. A study conducted in U.S.A. has shown that when the number of median openings per mile increased from 3 to 6, the accidents per million vehicle miles increased from 0.20 to 0.60 [Srinivasan, 1991b].

5.2.11 Road Intersections

Conflict points at an intersection area affects traffic safety. Larger the number of conflict points, greater is the probability of vehicle collision. Road intersections are normally major bottlenecks and accident spots and as many as 25 per cent of all accidents occur at road intersections. The number and type of accidents at intersections are strongly influenced by the characteristics of the intersection, volume and mix of traffic and the type of control system [Srinivasan, 1991b].
5.2.12 Vehicle Speed

Studies have shown that the severity of accident increases rapidly at higher driving speeds and more we have uniform speed of vehicles on the road, fewer are the accidents. Speed zoning on roads with high accident rates has in many cases yielded useful results. Speed limits also have been found to be useful in accident prevention. The 85 kmph speed limit imposed in the U.S.A., resulted in a reduction of 9000 road deaths during the first year. To be effective the speed limit must be such that a majority of motorists will observe it voluntarily and the enforcement can be directed to the minority [Srinivasan, 1991b].

5.3 SUMMARY

It is seen that there are number of factors like traffic volume, mix of modes, type of vehicles, pedestrians, traffic segregation measures introduced and road geometrics influence the accident scene. Any model to study the traffic accident scene should therefore be comprehensive and accommodate all these factors.