

# Impact of roadway condition, traffic and manmade features on road safety

Er. Hemant Gulati<sup>1</sup>, Dr. Devinder Sharma<sup>2</sup>, Er. Neeraj Kumar<sup>3</sup>

<sup>1</sup>M.tech, SRMIET, Bhurewala, Ambala

<sup>2</sup>Director, SRMIET, Bhurewala, Ambala

<sup>3</sup>Assistant Professor, SRMIET, Bhurewala, Ambala

**Abstract-** India is a developing country and safety of roads is still in a premature stage. Accident severity is increasing due to increasing in vehicle population. The road accident situation in India is alarming. Records show that there is one death at every 4 minutes because of road accidents. Road Safety is necessary to reduce accident involving both human and vehicles there by making the road more safe and user friendly to traffic. Area selected for the study was the Ambala Chandigarh Expressway section (km 5.735 to km 39.960 on NH-22 and 0 km to 0.871 km on NH-21). The location in a roadway where the traffic accident often occurs is called a black spot. . The safety deficiencies were detected to minimize accidents and save the road users. The deficiencies along with the measures for further improvement have been presented in this paper.

**Keywords – Impact, Roadway condition, Traffic, Road safety, Black spot analysis.**

## I. INTRODUCTION

Road safety is one of the most important problem in our society. Every year 1.24 million of people are killed and between 20 to 50 million people are injured in road accidents. If the current trends of road accidents continue then it will be predicting to be third leading contributor to the global burden of diseases and injury by 2020.

India had earned the dubious distinction of having more number of fatalities due to road accidents in the world. Road safety is emerging as a major social concern around the world especially in India.

Accidents are a drain on the national economy and may lead to disablement, death, damage to health and property, social suffering and general losses to the environment.

To minimize the number of crashes by any kind and severity expected to occur on the entity during a specific period is known as road safety. Accidents and the fatalities on road are the result of inter-play of a number of factors. Road users in India are various in nature, ranging from pedestrians, animal-driven carts, bi-cycles, rickshaws, hand carts and tractor trolleys, to various categories of two/three wheelers, motor cars, buses, trucks, and multi-axle commercial vehicles etc. The vehicle population has been gradually increasing because of change in the style of living of people. Increase in vehicle population with limited road space used by a large variety of vehicles has heightened the need and urgency for a well thought-out policy on the issue of road safety. In India the rate of accident is directly proportional to growth of vehicle population.

Road accidents are a human tragedy, which involve high human suffering. They impose a huge socio-economic cost in terms of untimely deaths, injuries and loss of potential income. The ramifications of road accidents can be colossal and its negative impact is felt not only on individuals, their health and

welfare, but also on the economy. Consequently, road safety has become an issue of national concern. Road safety is a multi-sectoral and multi-dimensional issue. It incorporates the development and management of road infrastructure, provision of safer vehicles, legislation and law enforcement, mobility planning, provision of health and hospital services, child safety, urban land use planning etc. In other words, its ambit spans engineering aspects of both, roads and vehicles on one hand and the provision of health and hospital services for trauma cases in post-crash scenario.

Causes of accidents and their contribution are as follows by statistics of Road accident in India (2016)

Drivers fault	- 77.5%
Defects in road condition	- 1.5%
Defects in motor vehicle	- 1.6%
Fault of bicyclist	- 1.3%
Fault of pedestrian	- 2.4%
Weather condition	- 1.7%
All other causes	- 14%

Road safety in India is the poorest in the world. According to MORTH 2013 India has the highest number of accidents in the world. Awareness among road users and safe design of road components is necessary to reduce accident involving both human and vehicles.

### Need and Objectives of Study

Very little work has been done in India to analyze accidents on four-lane roads.

The major objectives of the present work are listed below:

- (i) To study the annual, monthly, daily and hourly variation in accident rate on selected road Ambala-Chandigarh section- (km 5.735 to km 39.960 on NH-22 and 0 km to .871 km on NH 21).
- (ii) To study the effect of traffic volume, and road capacity on accident rate.

- (iii) To study the maintenance of road surface and shoulder w.r.t. road accidents.
- (iv) To develop an accident prediction model based on annual average daily traffic, road condition, road side features.

## II. LITERATURE REVIEW

### Driver characteristics

#### Alcohol and Drugs

The leading cause of traumatic death is motor vehicle accidents, falling accidents and blunt trauma. The use of drugs such as alcohol or illicit such as opium, cocaine increases the risk of trauma by traffic collision. Other drugs such as benzodiazepines increase the risk of trauma in elderly people. **Keall et al., (2002)** investigated the effect of alcohol, driver age and influence of passengers of driver fatal injury in New Zealand.

#### Speed

Driving speed is an important factor in road safety.

**Golob and Recker (2003)** analyzed accident in southern California and found accident characteristics as a function of traffic flow characteristics, controlling for lighting and weather condition. Result indicated that type of collision is strongly related to median traffic speed and temporal variation in speed in the left and interior lanes. Hit-object collision involving multiple vehicle that are associated with lane-change maneuvers are more likely to occur on dry roads during day light controlling weather and light condition.

#### Cell phones

**Tornros and Boiling (2005)** conducted an experiment with 48 drivers by covering a distance of 15 Km on a rural two-lane road. They concluded that driving performance reduced by dialing hand held phone and speed decreased with hands free phone. Reaction time to warning sign at road side decreased for hand held phone user.

#### Vehicular characteristics

Vehicle plays an important role in a crash. This may be due to defective wheel alignment, tyre bursting, brake failure, overloading, one or two head light defect, back light defect, indicator defect, steering defect.

#### Overloading

**Chan (2008)** overloading truck reduces braking ability of truck, stability of truck, unexpected defect of road and damage of vehicle. Fatal crashes involving overloaded large truck increases by 52%.

#### Brake Failure

**Oduro (2012)** surveyed a number of accident and found that 83% brake failure result in accident. Brake ineffectiveness is due to vehicle overloading, uneven tyre pressure, incorrect brake adjustment, air in braking system, automatic brake adjuster not working, brake fluid on lining. Brake failure is due to broken pipe, low brake fluid level, cracked brake drum, brakes overheating.

#### Environment characteristics

#### Volume

**Kurlaftis and Golias (2002)** studied between road geometric characteristics and accident rate. They found AADT, lane width, serviceability index, friction, pavement type, access control are the main factor contributing to accidents. Relative importance was 100% for AADT, 72% for lane width, 59% for serviceability, 32% for friction, 30% for pavement type and 14% for rural four-lane road.

#### Surface Discontinuity

**Forest et al., (2009)** established a relationship between accident data and surface discontinuities (pavement edge drops, pavement ruts, potholes etc.). Number of accidents from discontinuity are shown in Table 2.1

**Table 2.1 Surface discontinuity and accidents**

Disturbance	Frequency	Disturbance	Frequency
Water	143	Patch	11
Dropped	173	Bump	9
Soft	71	Dip	9
Curb	62	Rocks	4
Edge	59	Ruts	4
Hole	34	Track	3
Rail	24	Manhole	2
Rock	19	Bump	2

#### Road Side Features

**Somchainuek et al., (2013)** investigated road side safety on Thai NH. The result showed that speeding vehicles were involved in roadside crashes accounted for about 70% of the total crashes and 30% of road side crashes were due to road side trees.

## III. DATA COLLECTION

The study aims at “Impact of Roadway condition, Traffic and Manmade Features on Road Safety” passing through Ambala Chandigarh Expressway. With this objective in view, the required data for last ten years of the Ambala Chandigarh Expressway from starting point to end point of the Ambala Chandigarh Expressway are collected from different sources are given below:-

- i) The only information available for accident studies is the FIR (First Information Report) lodged in the police stations. The data from these records of last ten years (2007-2016) were extracted from the FIR record filed under IPC no. 279/337/338. Vehicle those involved in accidents and reported in the F.I.R. The categories of vehicle include tempo, auto, mini-truck, mini-bus, Tata-407, motor cycle, tanker, tailor (articulated vehicle), truck and bus.
- ii) The data for roadway condition, traffic sign, traffic signal and manmade features are collected from field study.
- iii) The details of road are collected from P.W.D (Public Work Department).

#### Data collected from police record

**Table 3.1 Details of accidents**

Year	Fatal	Major injury	Minor injury
2007	20	30	37
2008	21	35	50
2009	16	25	45
2010	15	32	39
2011	13	33	40
2012	04	36	84
2013	11	24	61
2014	18	29	81
2015	12	20	84
2016	14	18	58
Total	144	282	579

**Data collected from field study**



**Fig. 3.1 Roadway condition on NH-22 (km 10.735)**



**Fig. 3.2 Parked vehicles in no parking zone near TVS agency**

**Data collected from P.W.D records**

**Table 3.2 - Traffic volume data**

Year	ADT	Avg. PCU PER DAY	PCU/HR
2007	14533	24656.11	1027.33
2008	12584	21501.46	895.89
2009	12679	21655.23	902.30
2010	10484	18102.40	754.26
2011	11280	21689.22	903.71
2012	13560	20870.56	845.22
2013	12700	19560.23	798.55
2014	14235	22786.54	954.23

2015	14500	23587.22	1003.32
2016	16230	22507	945.23

#### IV. 4.ANALYSIS OF DATA & DISCUSSION

##### 4.1 Accident Rate and Frequency

Accident Rate =  $M/L$

Where M = Total number of Accidents of a stretch

L = Length of Road

**Table 4.1 Accident Rate**

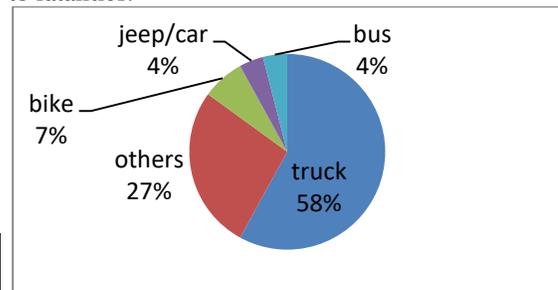
Name of Stretch	Length	No. of in a year Accidents	
		Sum of 10 year	Accident Rate
Ambala Chandigarh Expressway	35 km	1005	28.71

**Table 4.2 Frequency of Accident**

Type of Accident	No. of Accidents (2007-2016)	Frequency	Total frequency
Fatal	144	14.32	14.32
Major Injury	282	28.06	42.38
Minor Injury	579	57.62	100
Total	1005	100	

##### 4.2 Vehicles Involved in Fatalities

Vehicle users related to fatalities during 2007-2016 are shown in pie chart in percent. The results indicate that 58% of fatalities are due to truck drivers followed by 27% by unknown driver, 7% by motor cycles, 4% by car and jeep, 4% by bus respectively as shown in fig. 4.4. They consume alcohol and drugs in long driving. As a result of which reaction time increases and loss of control occurs during speed driving leads to fatalities.



**Fig. 4.1 Vehicle involved in fatalities during (2007-2016)**

#### V. ACCIDENT INVESTIGATION & BLACK SPOT ANALYSIS

##### Accident Investigation

Accident no.-1

Accident type: Collision with tree

Location: Jindal industries ltd., Baldev nagar

Date and Time: JUN13,2014,12:30PM

Vehicle 1: Ashok Leyland trailer

Vehicle 2: Bajaj Auto

Fatalities/Injuries: Two person minor injured

Discription: The trailer was on the highway with normal speed. At a T-junction one auto with nine passenger was changing direction (left turn) from bus stop road to highway. Both vehicles became front to front. The trailer driver applied sudden brake and struck the vehicle with a old tree present at

corner of junction. The auto was escaped from collision. Driver and helper became injured.

#### Black Spot Analysis

The point where accident occurs frequently is known as black spot or accident point. Analysis is required for improving traffic environment. The detail analysis of selected stretch is shown in Table 5.1.

**Table 5.1 Black Spot Analysis**

Accident Point	Nos.	Problems	Safety Enhancement
Sultanpur chowk, Ambala	18	Unsignalized intersection, on-street parking of vehicle	Junction improvement, no parking sign should be provided
Temporary casting yard	17	Bad shoulder, trees on shoulder	Installation of speed breaker, Clearance of obstruction on shoulder
Maruti Nexa showrum, Lalaru, Ambala	7	On-street parking, paved shoulder without marking	Installation of speed breaker and marking should be provided
Mobility Solution ltd.	5	On-street parking	Installation of speed breaker and no parking sign
D.k Resort & Restorant pvt. Ltd.	11	On-street parking, trees and poles on shoulder	Clearance of obstruction on shoulder
Mahindra dealership and Naresh engg. & steel fabrication	13	Vehicle parking on shoulder, trees and poles on shoulder	Clearance of road side
H.P fuel station , kakru	5	Bad shoulder, front area of petrol pump damaged	Petrol pump front should be repaired, shoulder maintenance
Lalru chowk, Bus stop	15	Signals are not provided, no marking	Signalization should be done
Derabassi Bus stand	20	Unsignalized, on-street parking	Signalization should be done, Installation of speed breaker

## VI. CONCLUSIONS

The following conclusions are drawn from the study:

1. The available literatures on accident analysis indicate that 77 percent of road accidents in India are caused due to driver's error.
2. Heavy vehicles like truck are involved in maximum number of accident on four-lane roads. It is estimated that fatalities caused by truck is (58 %) followed by other (27 %), bike (7 %), car/jeep (4 %) and bus (4 %). Road safety awareness should be raised among road user.
3. Most of the accident occurs due to:
  - Unsignalized intersection.
  - Absence of clearance on shoulders.
4. On the basis of analysis of data, characteristics of accidents and field visits conducted for the study, remedial measures have been suggested to reduce accidents on the accident-prone segments and to make road safer to road user.
  - Provision of traffic lights and road markings.
  - Strict enforcement of regulations.
  - Removal of old girth trees on shoulder.

- Periodic maintenance of road and traffic signals.
- Improvement of sharp curves.
- Avoiding of overloading.

## VII. SCOPE FOR FURTHER STUDY

Further study can be done to improve road safety by developing accident prediction model based on different methodology and then by applying remedial measures.

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