

**Identification of Black Spots on National Highways -A Case Study**Adnan<sup>1</sup>, Manish Kaushal<sup>2</sup><sup>1,2</sup>Civil Engineering Department, RIMT University, Punjab

**Abstract**— World Health Organization in their global status report on road safety presented in 2009 revealed that more people die in road accidents in India than anywhere else in the world, including the most populous China. This also been seen that traffic fatalities increased by about 5% per year from 1980 to 2000 but for now the rate of traffic fatalities has jump up to 8% per year in recent years. The reasons in the increase in percent of fatalities are may be due to increase in number of vehicles in recent years and secondly due to absence of coordinated official policy to control the problem. In economic terms, the cost of the road crash injuries is estimated at roughly one percent of gross national product in low income countries, 1.5 percent in middle income countries and 2 percent in high income countries. The management of accident risk is both a short-term and a long-term strategy, which requires support of central and state authorities. The most effective way of managing accident risk is through the development of a 'safety culture'. A safety culture is the beliefs and ideas shared by all members of an organisation about accidents and their risk of happening and proper measure which are to be taken to decrease in the number of accidents. The accident analysis and identification of black spots has been done for the corridor comprises the section of National Highway-21 commencing from Km 73.200 Km (Kiratpur Sahib in the state of Punjab) to km. 186.500 (Nerchowk in the state of Himachal Pradesh). The traffic volume on this particular section is very high as this road connects with various important cities of the state

**Keywords**—Accident studies, black spots, severity index, accident audit.

**I. INTRODUCTION**

According to the official statistics (National Crime Records Bureau), In India in 2008, 118,239 people were killed in road accidents. The death rate in India is about 10 to 20 time higher then high income countries like Japan, Australia, UK, and USA. In India the share of national highways and state highways is about 6 to 7 % of the total road networks but it cater to about 70 to 75% of total traffic. However in India only national highways comprises of only 2% of total road network, which account for 20% of total road accidents and 25% of total traffic fatalities. The year wise road accidents in India are shown in the table given below Accident is an event, occurring suddenly, unexpectedly and inadvertently under unforeseen circumstances. An accident may be defined as a collision occurred on a way or street open to public traffic (The collisions may be between vehicles; between vehicles and pedestrians; between vehicles and animals; or between vehicles and geographical or architectural obstacles) resulting in killing or injuring of one or more persons and involvement of at least one moving vehicle. 'Accidents are not natural but they are caused' is a common cliché in the area of traffic safety. Thus if accidents are caused by some, surely the ones responsible for could be identified and appropriate remedial measures developed and implemented to the extent feasible. The deaths per 1000 vehicles registered in some developing countries are shown in Fig 1 To cater the issues developed by this phenomenon, the governing authorities have taken up initiatives over the years, in the form of programs that have mainly focused on providing basic infrastructure services and utilities to the cities and have not paid much attention in achieving sustainability in the approach. Various initiatives in the form of policies, schemes and missions have been adopted by the government of India to tackle the above issues. Recently, India also introduced the smart city mission, which is somewhat on the similar lines of smart development. The mission's aim is to enhance the economic development of the identified cities with special focus towards on improving living standards of the population. Since, the development is been interpreted differently among the nations due to non-standardization of the concept, it's important to understand how the concept has been represented in Indian context.

**1.1 ACCIDENT SCENARIO IN INDIA**

The fast growth in the Road Transportation Sector in India has been a key element in the economic development of the country. But on the other hand this fast growth in Transportation Sector led in to increase in traffic accidents too. During 2008 India ranked fourth in the world among leading deaths due to accidents. In 2008 more than 1 lakh people die in road accidents and around 5 lakh people injured due to accidents in India. India's motor population is just 1% of the worlds but her share of the world traffic accident is 6%. Though the accident rate is decreased during the last 25 years due to awareness among people education and safety programmes but still the accident rate is very high as compared to the developed nations. Fig-2 shows that most of accidents take place in India because of the fault of road user only.

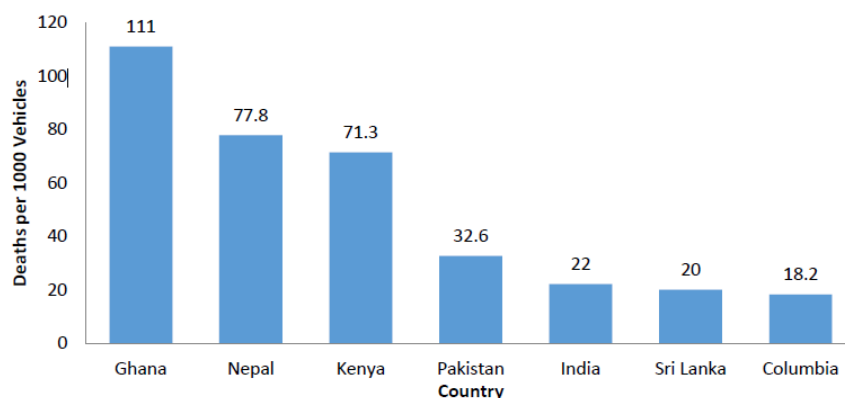


Fig1 Comparison of death/1000 vehicles among various developing countries (source-Accidental Deaths & Suicides in India Published by National Crime Records Bureau)

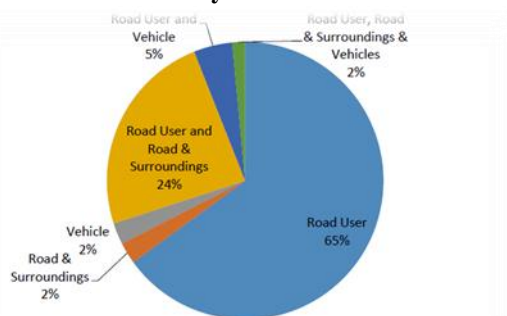


Fig.2 showing that most of accidents take place because of the fault of road user only (source-Accidental Deaths & Suicides in India Published by National Crime Records Bureau)

## II. STUDY AREA & DATA COLLECTION

### 2.1STUDY AREA

The corridor comprises the section of National Highway-21 commencing from Km 73.200 Km (Kiratpur Sahib in the state of Punjab) to km. 186.500 (Nerchowk in the state of Himachal Pradesh). The traffic volume on this particular section is very high as this road connects with various important cities of the state. Many tourists travel on this road because of the popularity and well known tourism of the state. This consists of all types of traffic i.e. buses, trucks, cars two-wheelers etc. Fig-3 shows the location of collected accident data (NH-21).



Fig-3 Location of collected accident data (NH-21)

### 2.2DATA COLLECTION

The present study is based on secondary source of data i.e. from the case diaries and police records of the accident case in all the district police stations which fall on this particular stretch. Simple random sampling technique was applied for the collection of accident data. Complete enumeration of data for six months (i.e. from October 2013 to march 2014) was done. Besides other relevant information were collected from the concerned officials through personal discussions and interviews.

**III. METHODOLOGY**

The two main parameters were calculated i.e. ASI & RMEV for identification of black spots and for the accident analysis. The calculation of these indexes is given below:

**3.1 ESTIMATION OF ACCIDENT SEVERITY INDEX (ASI) :** For estimation of ASI, the weight age to fatal accidents is assigned as 7 and to grievous injury accident as 3 Based on Fatal & Grievous Accidents

$$ASI = (N_f \times W_f) + (N_g \times G_g)$$

Where,

$N_f$  = No of fatal accidents at the location

$W_f$  = Weight age assigned to fatal accident

$N_g$  = No of fatal accidents at the location

$W_g$  = Weight age assigned to fatal accident

**3.2 CALCULATION OF RMEV:** The RMEV (rate per million of entering vehicles) is defined as the number of crashes per million vehicles entering the study location during the study period. It is expressed as

$$RMEV = (A \times 1,000,000)/V$$

Where

RMEV = crash rate per million entering vehicles

A = number of crashes, or by type occurring at the location

V= average daily traffic (ADT) X 183 (for six months)

**IV. RESULTS & DISCUSSIONS**

Table 1 shows the calculation of ASI for various locations from the collected data. The ASI will be used for the identification of black spots.

**Table 1 Calculation of ASI for various locations**

Name of the location	No of fatal accidents ( $N_f$ )	Weight age to fatal accidents ( $W_f$ )	No of fatal accidents ( $N_g$ )	Weight age to fatal accidents ( $W_g$ )	ASI= ( $N_f \times W_f$ ) + ( $N_g \times G_g$ )
Baner	0	7	1	3	3
Nouni	0	7	1	3	3
Lakhanpur	1	7	0	3	7
Ghagas	0	7	1	3	3
Beri	0	7	2	3	6
Barmana	1	7	3	3	16
Salapar	0	7	1	3	3
Harabagh	0	7	3	3	3
Bhojpur	0	7	1	3	3
Sunder nagar	0	7	5	3	15
Hamsafar	0	7	1	3	3
Control Gate	0	7	1	3	3
Nowlakha	0	7	4	3	12
Nerchowk	1	7	9	3	34
Naresh Chowk	1	7	0	3	7
Lagat	1	7	0	3	7
Dintol	0	7	1	3	3
Jamili	1	7	0	3	7
Lalit Chowk	0	7	1	3	3
Dhanutu	0	7	3	3	9
Punk	0	7	1	3	3
Salar	0	7	1	3	3
Near Santosh Mata Temple	0	7	1	3	3
Gutkar	0	7	1	3	3
Caular	0	7	1	3	3

**4.1 BLACK SPOTS**

Hazardous spots with accident severity index (ASI) more than threshold value (average severity + 1.2 (standard deviation)) are treated as black spot as shown in Table-2

Average Severity =  $165/25 = 6.6$

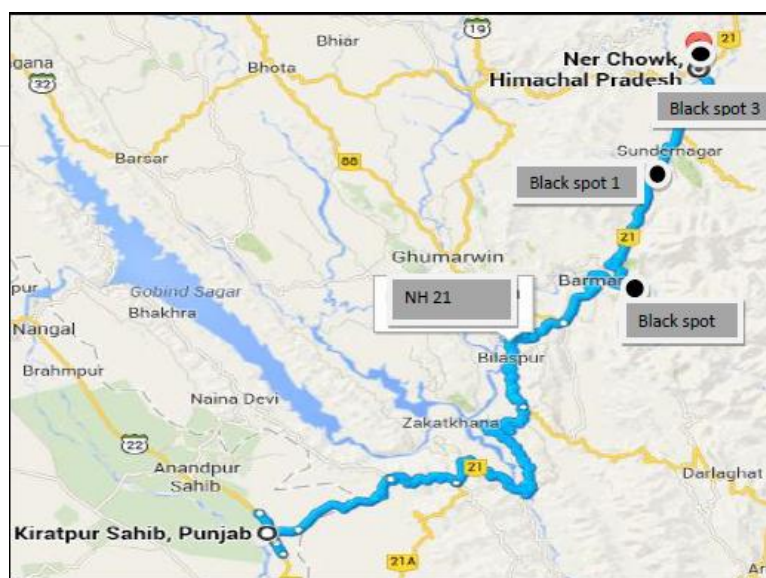
Standard Deviation = 6.89

Threshold value = 14.81

There are three Spots having ASI more than threshold value which are treated as Black Spots. These black spots are marked in the figure 4

**Table 2 Spots marked as black spots and their ASI values**

SPOTS	ASI	Reasons for accident	Mitigation Measures
Nerchowk	34	Over speeding	Speed sign has to be required
Sunder nagar	16	Over speeding	Service roads need to b provided
Barmana	15	Bad condition of road, Over speeding	Speed signs have to be provided; Service road for Barmana cement should be provided.



**Fig 4 Location of black spots**

Table-3 shows the calculation of RMEV for various locations.

**Table 3 Calculation of RMEV**

Location	No of crashes	Average Daily Traffic	V=ADT X 183	RMEV =( A X 1000000)/V
Baner	1	18293	3347619	0.30
Nouni	1	18293	3347619	0.30
Lakhanpur	1	18293	3347619	0.30
Ghagas	1	18293	3347619	0.30
Beri	2	18293	3347619	0.60
Barmana	7	18293	3347619	2.09
Salapar	1	18293	3347619	0.30
Harabagh	3	18293	3347619	0.90
Bhojpur	1	18293	3347619	0.30
Sunder nagar	5	18293	3347619	1.49
Hamsafar	1	18293	3347619	0.30
Control Gate	1	18293	3347619	0.30
Nowlakha	4	18293	3347619	1.19
Nerchowk	14	18293	3347619	4.18
Naresh Chowk	2	18293	3347619	0.60
Lagat	2	18293	3347619	0.60
Dintol	1	18293	3347619	0.30
Jamili	1	18293	3347619	0.30
Lalit Chowk	1	18293	3347619	0.30
Dhanutu	3	18293	3347619	0.90
Punk	1	18293	3347619	0.30
Salar	1	18293	3347619	0.30
Near Santoshi Mata Temple	1	18293	3347619	0.30
Gutkar	1	18293	3347619	0.30

Figures 5 to 10 shows results of various accident parameters analyzed from the collected data. Fig 5 shows Percentage wise Nature of accident, Fig 6 shows Percentage wise different type of vehicles responsible for accidents, Fig 7 shows Percentage wise causes of road accident, Fig 8 shows Nature of accidents, Fig 9 shows Percentage wise accidents on different condition of road and Fig10 shows Accidents in different weather condition

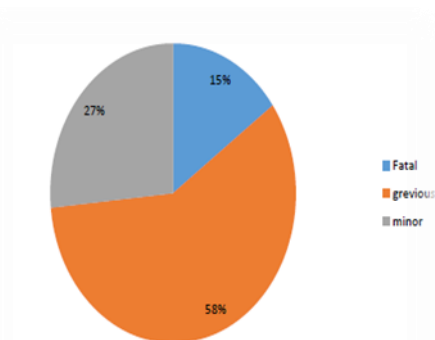


Fig 5 Percentage wise Nature of accident

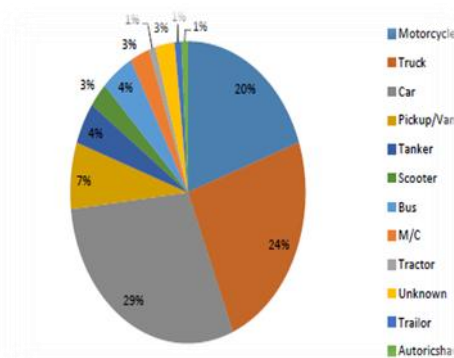


Fig 6 Percentage wise different type of vehicles responsible for accidents

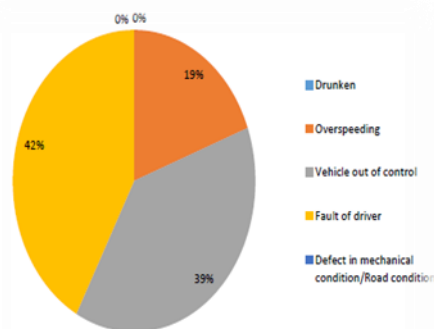


Fig 7 Percentage wise causes of road accident

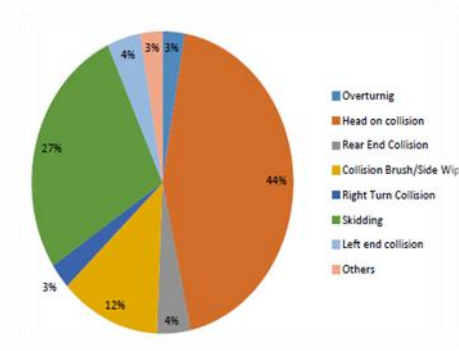


Fig 8 Nature of accidents

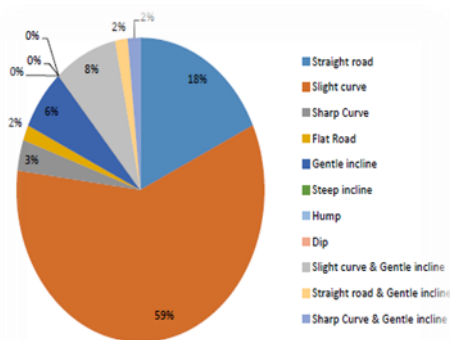


Fig 9 Percentage wise accidents on different condition of Road

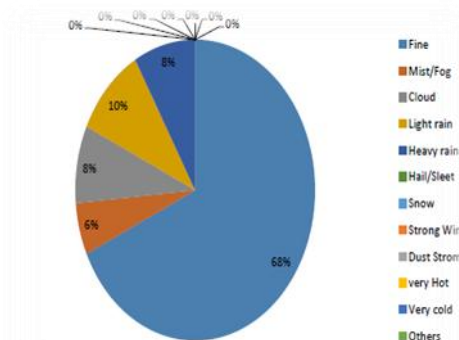


Fig10 Accidents in different weather condition

## V. CONCLUSION

The study was undertaken to know about the various causes of accidents and frequency of accidents to locate the black spots and to study the various aspects of Road Safety Audit. The accident data is collected for the six months of the National Highway 21 (Kiratpur to Nerchowk section) from the district police head quarter falling in this particular stretch of the section. There are three districts police head quarters which come in this stretch (Kiratpur, Bilaspur & Mandi). The data was collected at the end of the every month for six months (from October 2013 to march 2014). For the Road safety audit during development phase of the road, drawing is collected to audit the design of vertical and horizontal curves. From the study following conclusion can be drawn

- Road Safety Audit is very important for controlling accidents and for the proper design and maintenance of the Highways
- There are three locations which are located as the black spots since the value of ASI of these locations is more than average ASI
- Total horizontal curve length provided generally less than required w.r.to degree of curvature.
- vertical curves length are inadequate for safe sight distance for 100kmph at many locations
- Checklist for layout, location and access to Fuel Stations and Properties along national highway has been prepared with the latest notifications of MORTH.

## VI. RECOMMENDATIONS

- Proper speed limit signs should be provided at the black spots
- Service roads need to be provided at some of the locations.
- Good quality materials should be used so as increase the life of the roads
- Proper shoulder width, median width should be provided.
- Proper co-ordination of horizontal and vertical curve should be done
- Vertical curve length should be provided as per IRC standards

## REFERENCES

- [1] Kowtanapanich, W. Black Spot Identification.
- [2] Singh, S. K., Mishra, A. "Road Accident Analysis: A case study of Patna city", Urban Transportation Journal
- [3] Roa, S. B., Madhu, E., Jaljihal, S., Reddy, T. S.(2005) "Accident studies on NH-5 between Anakapalli to Vishkhapatnam" Proceedings of the Eastern Asia Society for Transportation Studies
- [4] Jain, S. S., Singh, P. K., & Parida, M. (2011). "Road Safety Audit for four lane National Highways". In 3rd International Conference on Road Safety and Simulation.
- [5] Vardaki, S., Papadimitriou, F., & Kopelias, P. (2014). "Road safety audit on a major freeway: implementing safety improvements". European Transport Research Review
- [6] IRC: SP: 88-2010. "Manual on Road Safety Audit ", Indian Road Congress, New Delhi, India.
- [7] IRC: SP: 73-1980. "Geometric Design Standards for Rural (non-Urban) Highways ",
- [8] IRC: SP: 23-1993. "Vertical Curves for Highways ". Indian Road Congress, New Delhi, India.
- [9] IRC: SP: 88-2010. "Manual on Road Safety Audit " Indian Road Congress, New Delhi, India.
- [10] Accidental Deaths & Suicides in India Published by National Crime Records Bureau, Ministry of Home Affairs, GOI, New Delhi; Various Issues
- [11] National Co-operative Highway Research Program (2004), Road Safety Audit, NCHRP, Synthesis, 336.
- [12] Ghee C., Silcock D., Astrop A., & Jacobs G. D. (1997), —Socio economic aspects of road accidents in developing countries“, TRL Report TRL247. Transport Research Laboratory, Crowthorne
- [13] Mungnimit, S., Jierranaitanakit, K., & Chayanan, S. (2009). "Sequential data analysis for black spot identification" In 4th IRTAD Conference, Seoul, Korea.
- [14] Karim, M. R., Marjan, J., Abdullah, S. "Road Safety Audit: challenges from the Malaysian experience