Identification and Improvement of Accident Black Spots on NH-3, Distt. Una (Himachal Pradesh) - A Case Study.

Thesis Submitted in Partial Fulfillment of the

Requirement for Award of the Degree

Of

MASTER OF TECHNOLOGY

In

CIVIL ENGINEERING

(Specialization in Transportation Engineering)

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DECLARATION

I hereby declare that the thesis work entitled "**Identification and Improvement of Accident Black Spots on NH-3, Distt. Una (Himachal Pradesh) - A Case Study"** is an authentic record of my own work carried out as requirements of thesis for the award of degree of M. Tech. in Civil Engineering (Specialization in Traffic & Transportation Engineering) from Lovely Professional University, Phagwara (Punjab), under the guidance of Mr. Ajay Kumar, during 2013 -2015.

The work has not been submitted to any other Institute for any degree.

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CERTIFICATE

This is to certify that the declaration statement made by this student is correct to the best of my knowledge and belief. The thesis "**Identification and Improvement of Accident Black Spots on NH-3, Distt. Una (Himachal Pradesh) - A Case Study"** submitted by **"RAKESH KUMAR",** bearing registration no. 11300705 student of school of Civil Engineering, Lovely Professional University, Phagwara, Punjab who carried out the thesis work under my supervision.

This report has not been submitted to any other university or institute for the award of any degree.

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ABSTRACT

As the population is increases day by day the numbers of vehicles are also increasing. As the vehicles are increasing, number of accidents also increases. The accidents are due to Human error or road parameters. Analysis of previous data indicates that 66% of the accidents occur due to human error and 33% due to road parameters such as road and vehicle interaction, other road user and environmental factors.

India has a road network of 3.3 million km consisting of National Highway (NH), State Highway (SH), Major District Roads (MDR) and Other District roads (ODR). National Highways constitute 2% of the total road length and carries more than 40% of passenger traffic and 85% of goods traffic has registered more accidents accounting for 20%, as compared to other roads.

Road safety has recently become a major concern in most modern societies. The identification of sites (black spots) that are more dangerous from accident point of view can help in better scheduling road safety policies.

The study includes collection of secondary accident data and prioritizing the accident prone locations by using Weighted Severity Index (WSI) method. WSI method follows a system of assigning scores based on the number and severity of accidents in that particular location in the last few years.

This paper lays emphasis on accident studies on the National Highway-3 in the District Una, State of Himachal Pradesh, India.

So the main aim of this study is therefore, to identify the major accident black spots on National Highway -3 and improvement in it.

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List of Abbreviations

Symbol	Meaning
API	Accident Prone Index
GDP	Gross Domestic Product
GIS	Geographic Information System
MDR	Major District Road
NCRB	National Crime Records Bureau
NH	National Highway
ODR	Other District Road
PCU	Passenger Car Unit
RS	Remote Sensing
SH	State Highway
UT	Union Territory
WHO	World Health Organization
WSI	Weighted Severity Index

Chapter 1

INTRODUCTION

1.1 Introduction:

The increase in the number of motor vehicles is due to the growth of population and fastly growth of technology and economics. As the mobility increases, the probability of accidents also increases. The basic elements in traffic accidents are road users, vehicles, road and its condition, road geometry and environmental factors etc. The fatality rate is more in developing countries as compare to developed countries.

The main cause of road accidents are drunken driving, careless and rash driving, over speeding, sudden braking, skidding, traffic rule violation, sudden twists and turns while driving etc.

Moreover, road accidents can affect 1% of annual gross product resources of the developing countries. Road accidents cannot be totally prevent/stop, but by using suitable traffic engineering, safety plan and management measures, the accident rate can be decrease. One of the most important factors to reduce traffic is identification of hazard locations.

During recent years, road safety and fastly growth of traffic has become a major concern throughout the world. Road traffic accident is a major problem leading to fatalities, injury and property loss and severely impacting the society.

According to the statistics released by National Crime Records Bureau (NCRB), approximately 1,39,091 persons lost their lives in 4,40,042 road accidents in India during 2012. Road accidents increase means number of vehicles also increases. In India tremendous increase in the total number of registered motor vehicles in last few years. According to a report total number of registered motor vehicles increased from about 0.3 million as on 31st March 1951 to 159.5 million as on 31st March 2012.

It is estimated that the economic losses due to road accidents in India are over Rs 100 billion per year. The identification of accident location, analysis and treatment of road accident

black spots are widely regarded as one of the most effective approaches to road accident prevention. Black spot is a place on a road that is considered to be dangerous because several accidents have happened there. Accidents happened their because of variety of reasons, such as a sharp curves in a straight road, so oncoming traffic is concealed, if design of junction are not proper on a fast road, poor or concealed warning signs at a cross-roads. Accident black spots can be improve by improving the signage, speed restrictions, improving sightlines, straightening bends etc.

In Himachal Pradesh in last ten years 33,922 accidents occur in which 10,727 peoples died and approximately 54,702 peoples injured. It shows that every year in Himachal Pradesh more than 1000 peoples died in road accidents. The major causes of road accidents in Himachal Pradesh are condition of roads are not good and also the rough driving is responsible for this.

1.2 Objectives of the study:

(i) By study we can find out the causes of accidents and suggest corrective measures at potential locations.

(ii) To develop a methodology for Road Safety.

(iii) To examine/check safety features adopted in the selected section of National Highway-3 and find out deficiencies in the road network due to which accidents occur.

(iv) To identify that the speed limits which are given their are matching with the actual vehicles speed on existing road profile of the highway section.

(v) To understand the nature of accidents and identify causes/problems along NH-3.

(vi) To provide recommendations based on this study for reducing accidents on NH-3.

1.3 Scope of the study:

The ultimate aim of this research work is to help, improve transport safety and reduce the impact of accidents.

The project's main purpose is to provide reliable predictors of road accidents for highway development models used in the planning stage of new or upgraded roads

1.4 Need of the study:

As the road accidents are increases day by day, it is necessary to stop this. So this study is for stop/reduce the number of accidents. The accidents can be reduce by identify the black spots on National Highway and improvement in it or by improving the road geometry.

Chapter 2

LITERATURE REVIEW

2.1 A brief review of the various studies on black spot identification is given as follow:

Srinivasan et. al. (1987): Developed a method for the identification and improvement of accident prone locations on national highways (NHs) in Kerala. The methods used for identify the black spots are:

i) Accident prone index (API) method

ii) WSI method.

The study concluded that the WSI method was found to be most suitable in identifying black spots on roads.

Srinivas Rao. B et. al. (2005): Conducted an accident study on NH-5 between Anakapalli to Visakhapatnam during the year 2003. Road where study done runs through urban, non- urban areas. The accident data for the last five years were collected from the related police station and analyzed thereafter.

Traffic studies done on the road such as road Inventory, Signage inventory, Signals, Traffic volume count, Speed and Delay. These accident study was conducted to improvement measures.

Dr. K. Krishnamurthy et. al. (2010): They conducted the accident study on three National Highways stretches spanning over 165 kilometers in Kerala. First stretch was National Highway-17 from Ramanattukara to Thrikkanapuram, of 75 km length. Second stretch was NH-212 from Nadakkavu to Churam View Point, of 53 km length. Third stretch was 34 km fromRamanattukara to Malappuram, at NH-213.

The accident data was collected from the related police stations from September 2006 to August 2009. They used the accident frequency and severity index methods to identify the

accident black spots in the selected stretches. The identified black spot points were ranked in terms of accident frequency and severity and top ranked spots were taken for more detailed study. In their studies they found black spots over six stretches which include two intersections and four black spots at curves. Then they suggested the points to improve the sites like traffic enforcement and widening of roads etc.

Binu B Pillai et. al. (2011): In this they study on Causes and Consequences of Road Accidents in Kerala, they pointed out the main causes of road accidents in Kerala and suggested remedial measures for improve it. According to them, the main causes of road accidents in Kerala are over speeding of vehicles and poor surface conditions, pedestrian crossing are not available, junction design is not proper, and absence of proper bus bay, check barriers, sign boards etc.

Nagarajanet. al. (2012): Used remote sensing (RS) & GIS for identification of black spots and accident analysis for a particular stretch of NH-45 starting from Tambaram to Chengalpet. They find the eleven accident locations by using high resolution satellite map (IKONS) based on the non-spatial data collected from police department and the field survey. In field survey they collect the data of traffic volume, vehicle spot speed, and plotting of the study stretch using Arc GIS software.

Pavan, R. Vyas et. al. (2014): They study on road stretch of SH-85 to determine the accident locations by using the WSI method.

The various factors, which tend to influence the occurrence of accidents on roads, are assigned weights on a scale of 1:10 in such a manner that the factor, which tends to increase the probability of the accidents are assigned lower weights. The total weights are calculated using a programmed Excel spreadsheet. For prioritization of the probable black spots different factor are considered and suitable weighs are given to each of these factors. These include road related factors like road geometrics, visibility conditions etc. which lead to accidents. For the study they select the following parameters:

1. Number of lanes in each direction 2. Width of road 3. Type of road
4. Signs & Signals 5. Types of vehicle.

2.2 Road accidents in World:

As the use of motor vehicles is continuously increasing globally, road traffic is also increasing. By the increasing the traffic the number of accidents are also increasing in world wide.

Accidents have become an increasing cause of deaths and injuries. The World Health Organizations report shows that almost 1.26 million people are killed in road accidents each year worldwide and approximately 50 million people are injured. Out of 50 million, half of them are seriously injured and nearly 3400 people die on the world's roads every day.

This time the road traffic injuries ranked ninth leading cause of the global burden of disease and injury. But World Health Organization estimates that in the year 2020,road accidents will become the world's third leading cause of death (after heart disease and deaths linked to mental illnesses/Depression) if no effective actions and efficient measures are taken.

Because of the continue economic growth, motorization and urbanization in developing nations are growing very fast. These create a pressure on the transport infrastructure, which is not sufficient or ready to meet such an increase in the number of vehicles and people.

The lack of institutional framework, not the proper use of engineering aspects, education, and law enforcement are some problems due to which severity value is increasing day by day.

Table 2.1: Ranking of major causes of death in 1990 & 2020.

1990		**2020**	
Disease/Injury	**Rank**	**Disease/injury**	**Rank**
Respiratory	1	Ischaemic heart disease	1
Diarrhoel diseases	2	Unipolar major depression	2
Perinatal	3	**Road traffic accidents**	**3**
Unipolar major depression	4	Cerebro vascular disease	4
Ischaemic heart disease	5	Pulmonary	5
Cerebro vascular disease	6	Respiratory	6

Tuberculosis	7	Tuberculosis	7
Measles	8	Diarrhoel diseases	8
Road traffic accidents	**9**	HIV	9
Congenital anomalities	10	Perinatal	10
Malaria	11	Congenital anomalities	11
Pulmonary	12	Measles	12

Source: Causes and Consequences of road accidents in Kerala, International Journal of Research in IT & Management, Vol. 1, pp.83-95, 2011.

2.3 Road accident scenario in India:

As the Mobility increases, the number of accidents also increases. Accidents are due to the carelessness, over confidence, high speed, heavy loading of goods, less use of traffic sign etc. Mix traffic is also a problem in India.

According to the Ministry of Road & Highways Government of India in 2011, total 4.97 lakh accidents occur out of which 1,42,485 deaths. And one death in every 3.7 minutes. Accidents impose significant costs of 3% GDP for India (1999-2000).

But the Global status report on road safety 2013 estimates that more than 2,31,000 people are killed in road traffic crashes in India every year.

It has been estimated that India currently accounts for nearly 10% of road accident fatalities worldwide. According to a report, 35.2% peoples died in India due to road accidents out of 100%, Which is the highest cause of death rate than any other cause of death rate in India.
The injuries and fatalities are the result of road accidents which are the big concern for a country in both social and economic terms. It is estimated that the accidents are more in developing countries as compare to developed countries.

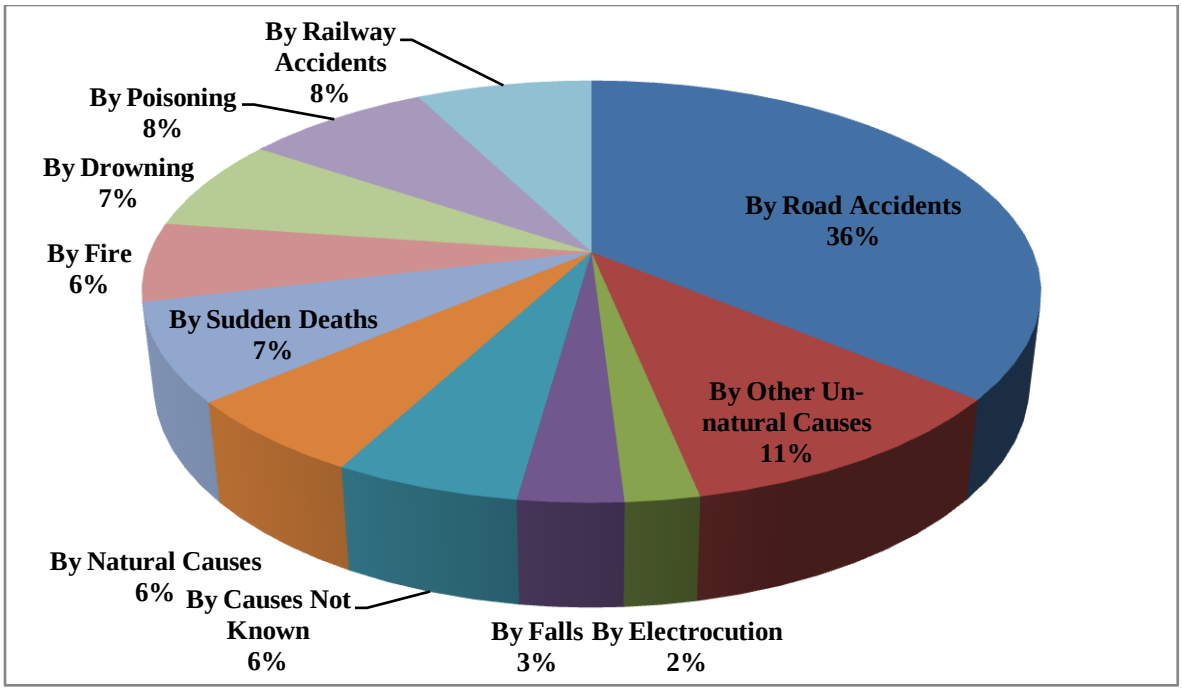


Fig 2.1: Percentage share of various causes of accidental deaths during 2012 (Natural and un-natural causes).

Source: Incidence and rate of accidental deaths during the decade (2002-2012).

Table 2.2: Road Accidents, Persons Killed and Injured 1970-2010:

Sr. No.	Year	Total Number of Road Accidents (in numbers)	Total Number of Persons Killed (in numbers)	Total Number of Persons Injured (in numbers)	Population of India (in thousands)	Total Number of Registered Motor Vehicles (in thousands)	Road Length (in kms)	Number of Accidents per Lakh Population	Number of Accidents per Ten Thousand Vehicles	Number of Accidents per Ten Thousand Kms of Roads	Number of Persons Killed per Lakh Population	Number of Persons Killed per Ten Thousand Vehicles	Number of Persons Killed per Ten Thousand Kms of Roads	Number of Persons Injured Per Lakh Population	Number of Persons Injured Per Ten Thousand Vehicles	Number of Persons Injured Per Ten Thousand Kms of Roads
1	1970	114,100	14,500	70,100	539,000	1401	1188,72	21.2	814.4	959.8	2.7	103.5	122.0	13.0	500.4	589.7

							8									
2	1980	153,200	24,000	109,100	673,000	4521	1491,873	22.8	338.9	1026.9	3.6	53.1	160.9	16.2	241.3	731.3
3	1990	282,600	54,100	244,100	835,000	19,152	1983,867	33.8	147.6	1424.5	6.5	28.2	272.7	29.2	127.5	1230.4
4	1991	295,131	56,278	255,000	852,250	21,374	2331,086	34.6	138.1	1266.1	6.6	26.3	241.4	29.9	119.3	1093.9
5	1992	275,541	60,113	267,200	869,000	23,507	2482,289	31.7	117.2	1110.0	6.9	25.6	242.2	30.7	113.7	1076.4
6	1993	284,646	60,380	287,800	886,000	25,505	2614,662	32.1	111.6	1088.7	6.8	23.7	230.9	32.5	112.8	1100.7
7	1994	325,864	64,463	311,500	904,000	27,660	2890,950	36.0	117.8	1127.2	7.1	23.3	223.0	34.5	112.6	1077.5
8	1995	351,999	70,781	323,200	924,359	30,295	2975,035	38.1	116.2	1183.2	7.7	23.4	237.9	35.0	106.7	1086.4
9	1996	371,204	74,665	369,502	941,579	33,786	3202,515	39.4	109.9	1159.1	7.9	22.1	233.1	39.2	109.4	1153.8
10	1997	373,671	76,977	378,361	959,792	37,332	3298,788	38.9	100.1	1132.8	8.0	20.6	233.3	39.4	101.4	1147.0
11	1998	385,018	79,919	390,674	978,081	41,368	3228,356	39.4	93.1	1192.6	8.2	19.3	247.6	39.9	94.4	1210.1
12	1999	386,456	81,966	375,051	996,130	44,875	3296,650	38.8	86.1	1172.3	8.2	18.3	248.6	37.7	83.6	1137.7
13	2000	391,449	78,911	399,265	1014,825	48,857	3316,078	38.6	80.1	1180.5	7.8	16.2	238.0	39.3	81.7	1204.0
14	2001	405,637	80,888	405,216	1028,610	54,991	3346,667	39.4	73.8	1212.1	7.9	14.7	241.7	39.4	73.7	1210.8
15	2002	407,497	84,674	408,711	1045,547	58,924	3383,344	39.0	69.2	1204.4	8.1	14.4	250.3	39.1	69.4	1208.0
16	2003	406,726	85,998	435,122	1062,388	67,007	3553,468	38.3	60.7	1144.6	8.1	12.8	242.0	41.0	64.9	1224.5

17	2004	429,910	92,618	464,521	1079,117	72,718	3621,507	39.8	59.1	1187.1	8.6	12.7	255.7	43.0	63.9	1282.7
18	2005	439,255	94,968	465,282	1095,722	81,502	3809,156	40.1	53.9	1153.2	8.7	11.7	249.3	42.5	57.1	1221.5
19	2006	460,920	105,749	496,481	1112,186	89,618	3880,651	41.4	51.4	1187.7	9.5	11.8	272.5	44.6	55.4	1279.4
20	2007	479,216	114,444	513,340	1128,521	96,707	4016,401	42.5	49.6	1193.1	10.1	11.8	284.9	45.5	53.1	1278.1
21	2008	484,704	119,860	523,193	1144,734	105,353	4109,592	42.3	46.0	1179.4	10.5	11.4	291.7	45.7	49.7	1278.1
22	2009	486,384	125,660	515,458	1160,813	114,951	N.A.	41.9	42.3	N.A.	10.8	10.9	N.A.	44.4	44.8	1273.1
23	2010	499,628	134,513	527,512	1176,742	N.A.	N.A.	42.5	N.A.	N.A.	11.4	N.A.	N.A.	44.8	N.A.	N.A.

Source: Government of India Ministry of Road Transport and Highway Transport Research Wing, New Delhi 2011.

Table 2.3: No. of Accidents, No. of Persons Involved & Accident Severity 2001 to 2010:

Number of Accidents and Number of Persons Involved: 2001 to 2010					
Year	**Number of Accidents**		**Number of Persons**		**Accident Severity**
	Total	**Fatal**	**Killed**	**Injured**	
2001	405,637	71,219 (17.6)	80,888	405,216	19.9
2002	407,497	73,650 (18.1)	84,674	408,711	20.8
2003	406,726	73,589 (18.1)	85,998	435,122	21.1
2004	429,910	79,357 (18.5)	92,618	464,521	21.5
2005	439,255	83,491 (19.0)	94,968	465,282	21.6
2006	460,920	93,917 (20.4)	105,749	496,481	22.9
2007	479,216	101,591 (21.1)	114,444	513,340	23.9
2008	484,704	106,591 (22.0)	119,860	523,193	24.7
2009	486,384	110,993 (22.8)	125,660	515,458	25.8
2010	499,628	119,558 (23.9)	134,513	527,512	26.9

Accident Severity: No. of persons killed per 100 accidents.

Source: Government of India Ministry of Road Transport and Highway Transport Research Wing, New Delhi 2011

Table 2.4: Severity of Road Accidents in India State/UT-wise (2007 to 2010).

Severity of Road Accidents in India (State/UT-Wise) : 2007-2010					
Sr. No.	State/UT	Persons Killed per 100 Accidents			
		2007	2008	2009	2010
1	Andhra Pradesh	30.6	32.4	33.9	35.2
2	Arunachal Pradesh	39.6	47.9	51.6	50.5
3	Assam	36.4	38.6	40.9	38.7
4	Bihar	44.8	43.8	43.6	46.6
5	Chhattisgarh	21.2	22.9	22.2	21.6
6	Goa	8.0	7.6	7.7	7.2
7	Gujarat	20.6	21.0	22.5	24.9
8	Haryana	36.8	38.8	38.6	42.2
9	Himachal Pradesh	33.1	30.8	37.4	35.9
10	Jammu & Kashmir	16.3	17.8	18.5	17.0
11	Jharkhand	39.4	39.7	43.4	46.0
12	Karnataka	18.9	19.0	19.3	20.7
13	Kerala	9.5	10.5	10.8	11.3
14	Madhya Pradesh	15.9	15.2	15.6	16.2
15	Maharashtra	15.2	16.4	15.8	17.3
16	Manipur	21.2	26.4	21.6	25.6
17	Meghalaya	42.3	41.8	36.4	34.4
18	Mizoram	64.9	57.3	69.8	65.6
19	Nagaland	37.2	92.1	87.3	114.3
20	Odisha	36.5	37.6	39.7	40.8
21	Punjab	64.6	62.7	65.9	64.3

22	Rajasthan	34.1	35.4	36.0	37.7
23	Sikkim	34.7	40.3	15.4	38.2
24	Tamil Nadu	20.4	21.2	22.6	23.7
25	Tripura	27.8	28.8	26.5	25.6
26	Uttarakhand	64.9	75.7	60.8	62.4
28	Uttar Pradesh	53.0	51.3	52.0	53.5
29	West Bengal	40.7	39.2	43.7	38.2
30	Andaman & Nacobar Islands	13.3	11.5	12.2	9.5
31	Chandigarh	28.3	30.7	40.3	30.3
32	Dadra & Nagar Haveli	56.9	56.0	57.0	64.6
33	Daman & Diu	48.3	58.0	52.4	64.6
34	Delhi	24.8	24.8	30.9	29.7
35	Lakshadweep	0.0	0.0	50.0	0.0
36	Pondicherry	14.6	12.5	12.8	15.6
	National Average	**23.9**	**24.7**	**25.8**	**26.9**

Source: Government of India Ministry of Road Transport and Highway Transport Research Wing, New Delhi, December 2011.

2.4 Road accidents in Himachal Pradesh:

Road is the dominant mode of transport in the state of Himachal Pradesh. The total length of the road network in the state is about 33,491 km. The state has 14 National Highways with a total length of 1,752.830 km as of 3rd March 2014. The State has 18 State Highways and 53 Major District Roads with a total length of 1,466.300 km and 2144.915 km. Himachal government invest lots of money on roads but the condition of roads are not good.

In Himachal every year more than 1,000 peoples died. In last ten years 10,727 peoples died and approximately 54,702 peoples injured in road accidents.

All-India average death rate is 32.6 deaths per one lakh of population but rate of Himachal is 46.9 which is higher than the country death rate.

Table 2.5: State / UT wise rate of accidental deaths in comparison to all India (Rate).

More accident prone			**Less accident prone**		
Sr. No.	**States/ UTs**	**Rate (more than 32.6)**	**Sr. No.**	**States/ UTs**	**Rate (less than 32.6)**
1	Pondicherry	80.1	1	A & N Islands	32.2
2	Chhattisgarh	58.2	2	Arunachal Pradesh	32.2
3	Goa	58.1	3	Mizoram	32.1
4	Maharashtra	54.1	4	Kerala	31.7
5	Madhya Pradesh	48.8	5	West Bengal	26.8
6	Tamil Nadu	48.2	6	Sikkim	26.0
7	**Himachal Pradesh**	**46.9**	7	Uttarakhand	24.7
8	Daman & DIU	46.7	8	Chandigarh	22.3
9	Haryana	46.2	9	Jharkhand	20.2
10	Delhi (UT)	43.6	10	Jammu & Kashmir	19.9
11	Gujarat	41.4	11	Meghalaya	19.7
12	Karnataka	39.7	12	Tripura	18.7
13	Punjab	38.2	13	Assam	15.4
14	Andhra Pradesh	34.8	14	Uttar Pradesh	14.7
15	D & N Haveli	34.6	15	Manipur	13.8
16	Rajasthan	34.3	16	Bihar	12.2
17	Odisha	33.1	17	Lakshadweep	9.1
			18	Nagaland	3.9

Source: Incidence and rate of accidental deaths during the decade (2002-2012).

The road sector suffers from a number of problems in Himachal Pradesh. Some of these are:

- Inadequate and sub-optimal allocation of resources for road maintenance.
- Absence of private public partnership in the development of the road sector.
- Not so much attentions towards the road safety.

2.5 Causes of road accidents:

Road accidents can occur due to various reasons. Usually such accidents are not caused intentionally. Accidents result due to a combination of different factors such as:

(i) Weather

(ii) Road factors

(iii) Driver & Violation of the rules

(iv) Condition of the vehicle.

(i)Weather:

Bad weather is also one of the biggest causes of road traffic accidents. Bad weather such as heavy rain, snow or fog can cause bad visibility. Also due to bad weather poor friction on road surfaces which lead to skidding/vehicles not able to stop and break in time and collide with each other or other objects.

(ii) Road factors:

The other important factors about the traffic accident are road factors. The roads which are in very bad conditions are also leads to the accidents.

Bad geometry of road can also create the problems. Another cause of road accidents is poor road designs. If geometric design of the road is not proper it also leads to accidents.

Road factor includes the Vertical alignment, Sight distance, Super elevation, Carriageway width, Width and condition of shoulders, Deficiency in road signs and road markings, Junction design, Formation of delineators and guard rails, Narrow bridges and culverts, Median width, Street lighting etc.

(iii) Driver & Violation of the rules:

One of the most important factors about the traffic accidents is violation of the rules which can be with exceeding speed limit, using alcohol. Exceeding speed limit causes great accidents because with this exceeding driver loses the control of his driving and then occur accidents which even result in deaths.

Violation of the rules can also be with using alcohol before driving. After getting alcohol, driver cannot pay attention to the road. Drivers which are not sleep properly are also sometimes leads to accident. Because of this they do not pay their full attentions to the road and they even fall asleep while they are driving. Unsafe overtaking, not stopping at the red traffic light and other common disregards of road rules.

Drivers lacking of knowledge is the other factor which causes accidents.. The drivers who have got their licenses from bad driving courses cause traffic accidents because they become drivers without having enough knowledge about driving, signs and traffic rules.

(iv) Condition of Vehicle:

Accidents can also happen on the road due to vehicle defects. Vehicle defects may be brake failure, Tire bursting, Steering system, Lighting system, Vehicle inspection and Maintenance. Defective car components such as airbags which do not deploy correctly can also cause people to suffer more serious injuries when involve in an accident and may even lead to death.

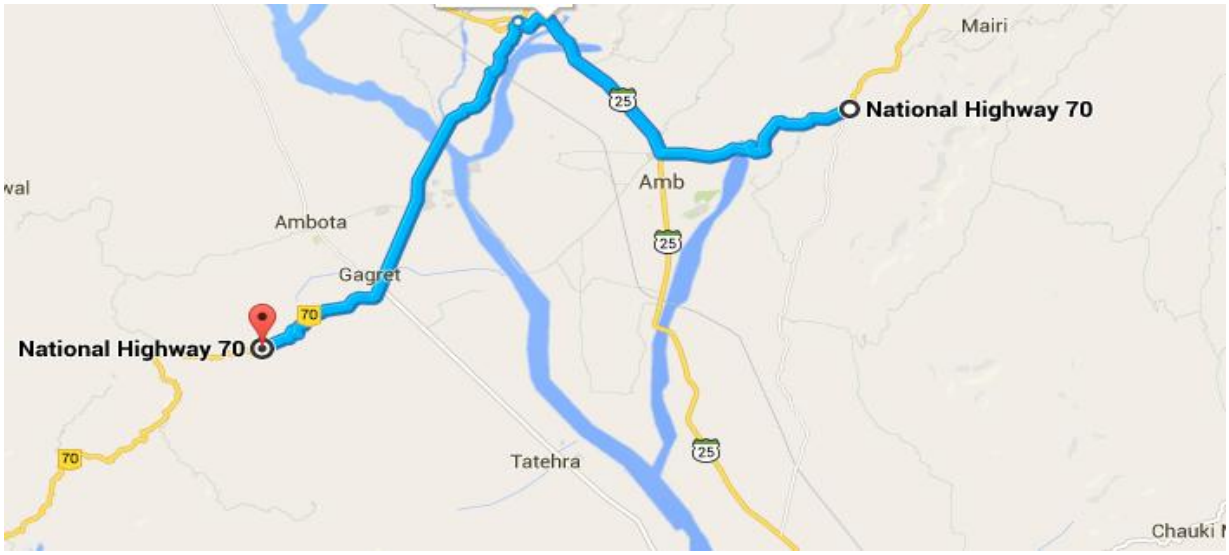
2.6 Site selection for study area:

The area which is selected for accident studies are 29 km long National Highway-3 section between Hoshiarpur (Punjab) - Una Border to Amb (Una) Himachal Pradesh.

National Highway-3 is a National Highway in Northern India. NH -3 connects Jalandhar in Punjab to Kullu – Manali road in Himachal Pradesh.

The total length of National Highway is 318.495 km.

Location Map of Road:



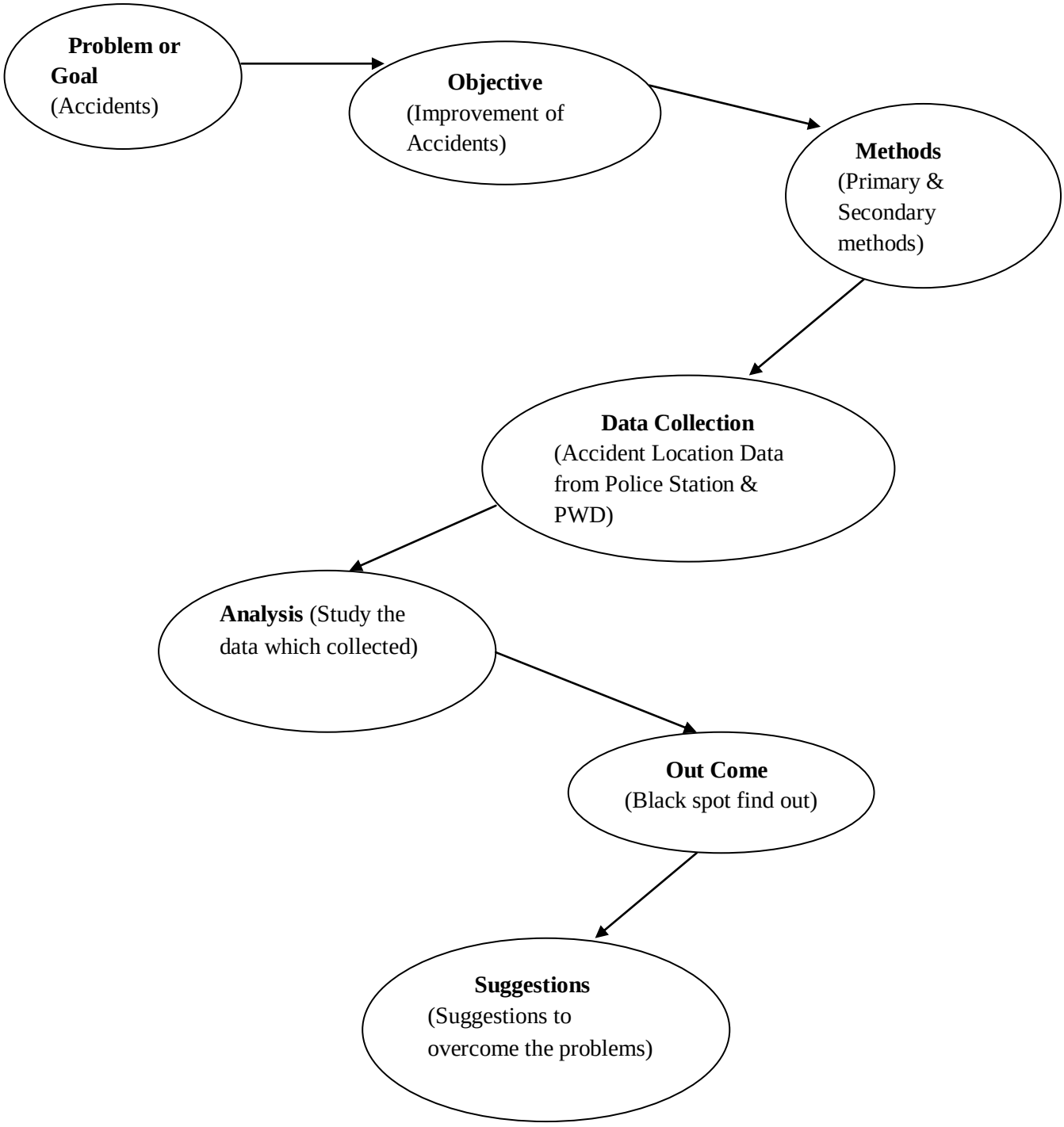
Map 2.1: National Highway-3.

Source: http://www.bing.com/maps

Chapter 3

APPROACH & METHODOLOGY:

3.1 Steps involves in study are following:



3.2 Methods use for study work:

- Primary method
- Secondary method by using WSI.

3.3 Data Collection:

3.3.1 Primary data

3.3.2 Secondary data.

3.3.1 Primary data:

For Primary data we needed the following:

3.3.1.1 Details of road Inventory

3.3.1.2 Signage inventory

3.3.1.1 Details of road Inventory: Road Inventory includes name of the road, Length of the road, Type of road (Flexible or Rigid), Width of the road etc.

(a)Name of the Road & Length of the Road:

Name of the road is Jallandhar, Hoshiarpur, Gagret, MubarikpurAmb, Nadaun, Hamirpur, Sarkaghat, Dharampur, Mandi, Kullu, Manali road.

Length of the Total Road:

Single Lanes (in kms.) 125.905.

Intermediate Lane (in kms.) 21.065

Double Lane (in kms.) 171.525

Total Length (in kms.) 318.495

But the length taken for case study is 29 kms. in Una Distt.

(b)Type of Road: The road is flexible types i.e. bitumen road.

Fig 3.1: National Highway – 3.

Source: http://www.bing.com/images/search?q=road%20amb%20una.

So in this we can collect the data related to the road inventory and study that what are the faults in that and how we can improve it.

(c) Bridges:

Table 3.1: Number of major and minor bridges with span and carriageway width.

Name of Bridge	Span (meter)	Carriageway Width (meter)	Type of Bridge
Gagret khad	105 m	6.60 m	Major bridge
Shiv bari	34 m	6.60 m	Minor bridge
Sawan gap	36 m	6.60 m	Minor bridge
Sawan River	158.60 m	6.60 m	Major bridge
Jangoli khad	77 m	5.50 m	Major bridge
Karlohi khad	186.55 m	5.50 m	Major bridge
Amb khad-1	18.25 m	5.50 m	Minor bridge
Amb khad -2	48.80 m	5.50 m	Minor bridge
Kheran Khad	53.20 m	5.50 m	Minor bridge

Source: Site visit data.

So there are 4 major bridges and 5 minor bridges with the carriageway width of 5.50 m to 6.60 m and span of 18.25 m to 186.55 m.

3.3.1.2 Signage inventory: Traffic signs are important elements of the highway because they guide, warn, and inform the drivers for the safely and efficiently movement on the roads. Well maintained signs are important as they help to drivers to make good decisions.

Fig 3.2: National Highway-3 with Sign Board.

Source: http://www.bing.com/images/search?q=road%20amb%20una.

So, in sign inventory we study about the different types of signs and their proper position where it is require. And Maintenance of signs are also very important.

3.3.2 Secondary data using WSI (Weighted Severity Index) method:

In this accident data is needed, which we can collect from the related area Police stations. And to analysis the secondary data we use the WSI method.

Weighted Severity Index, (WSI) = (5 x K) + (3 x GI) + (1 x MI)

Where, **K** is the number of persons killed,
GI is the number of injured,
MI is the number of non - injured.

After calculations we get the value of WSI by which we can find/tell that on which point of road has more Weighted Severity Index value and consider it as black spot. More the Severity value more the dangerous road section/site.
By this we get the black spots and we can find the causes of accidents at their and how we can improve/stop it.

3.4 Analysis of Secondary data:

3.4.1 Different types of data collected from Police stations:

Table 3.2: Road Accidents in Distt. Una (Himachal Pradesh): 2011 to 2014

Year	Total Accidents	Deaths	Injured	Non-Injured	Severity Index
2011	257	85	442	6	1757
2012	239	57	436	5	1598
2013	239	63	462	4	1705
2014	259	82	391	9	1592

Source: Office of the Superintendent of Police Una, Distt. Una (H.P.).

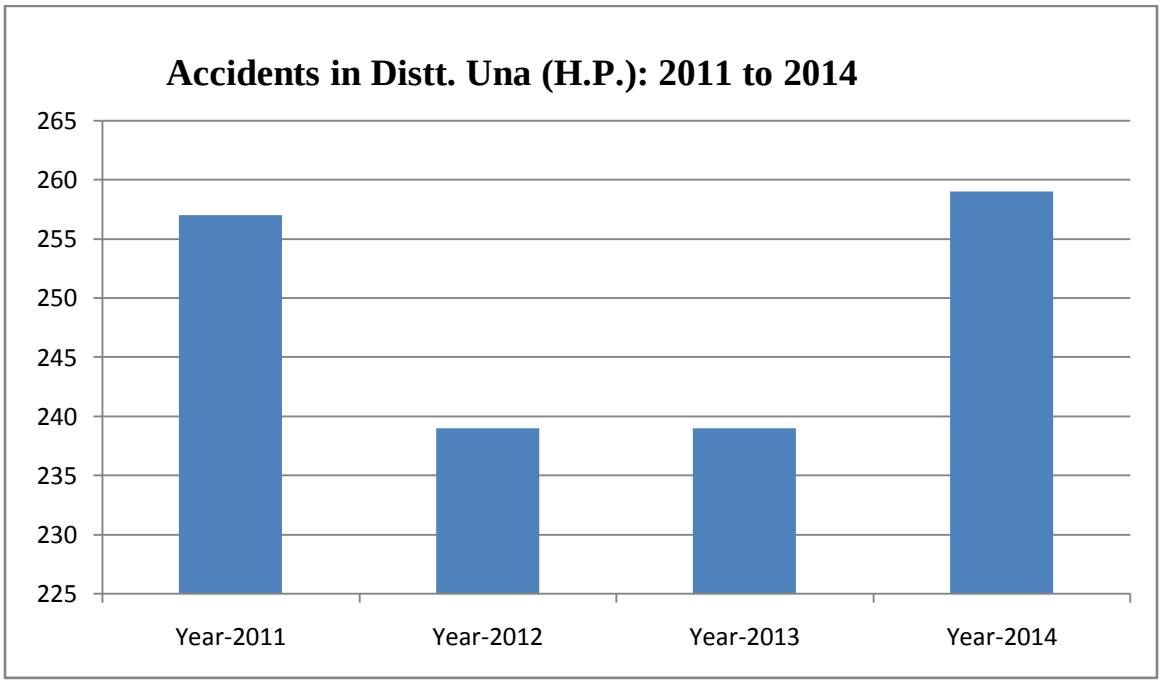


Fig 3.3: Road Accidents in Distt. Una (Himachal Pradesh): 2011 to 2014.

Source: Office of the Superintendent of Police Una, Distt. Una (H.P.).

Table 3.3: Road Accidents on NH-3: 2011 to 2014

Year	Total Accidents	Deaths	Injured	Non-Injured	Severity Index
2011	16	5	25	0	100
2012	12	2	15	0	55
2013	3	1	5	0	20
2014	9	6	20	0	90

Source: Office of the Superintendent of Police Una, Distt. Una (H.P.).

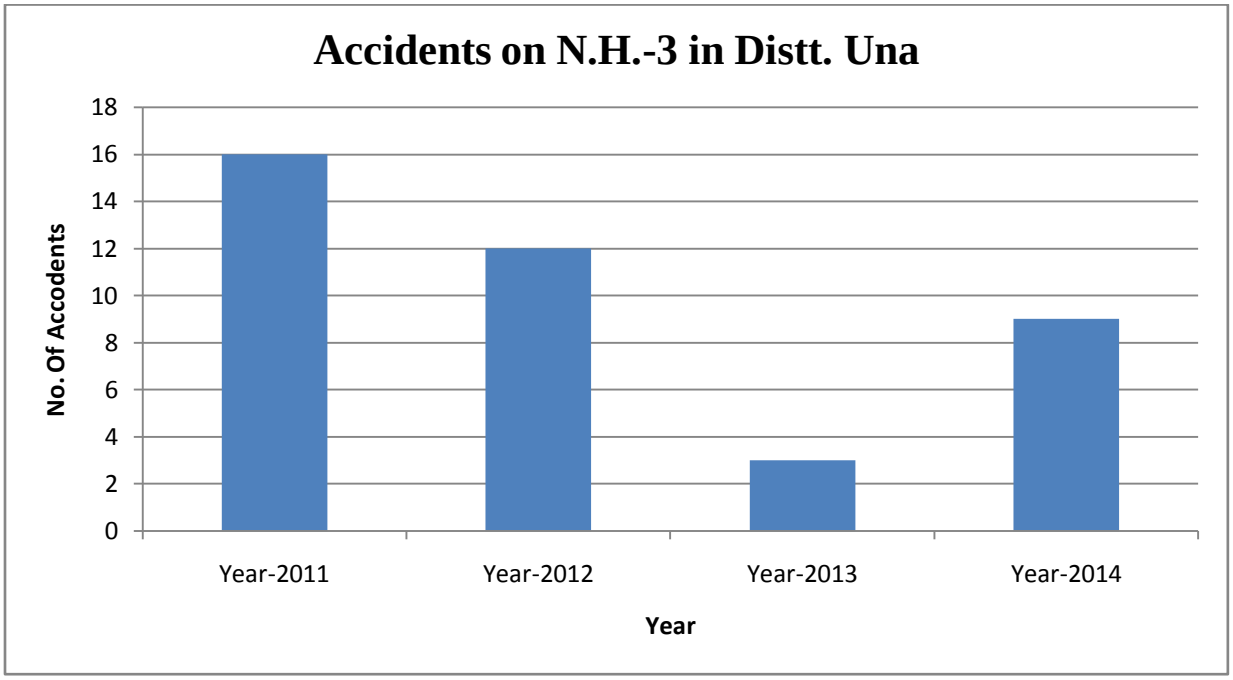


Fig 3.4: Road Accidents on NH-3 in Distt. Una (Himachal Pradesh): 2011 to 2014.

Source: Office of the Superintendent of Police Una, Distt. Una (H.P.).

Table 3.4: Types of Vehicles Involved in Accidents on NH-3: 2011 to 2014

Year	Bus	Truck	Car	Jeep	Motor Cycle	Tractor	Three Wheller	On Foot
2011	2	5	4	1	3	1	0	0
2012	0	1	4	0	7	0	0	0
2013	1	1	0	0	1	0	0	0
2014	2	4	2	0	1	0	0	0

Source : Office of the Superintendent of Police Una, Distt. Una (H.P.).

Table3.5: Number of Accidents at Day or Night on NH-3: 2011 to 2014

Year	Day	Night
2011	13	3
2012	8	4
2013	2	1
2014	6	3

Source : Office of the Superintendent of Police Una, Distt. Una (H.P.).

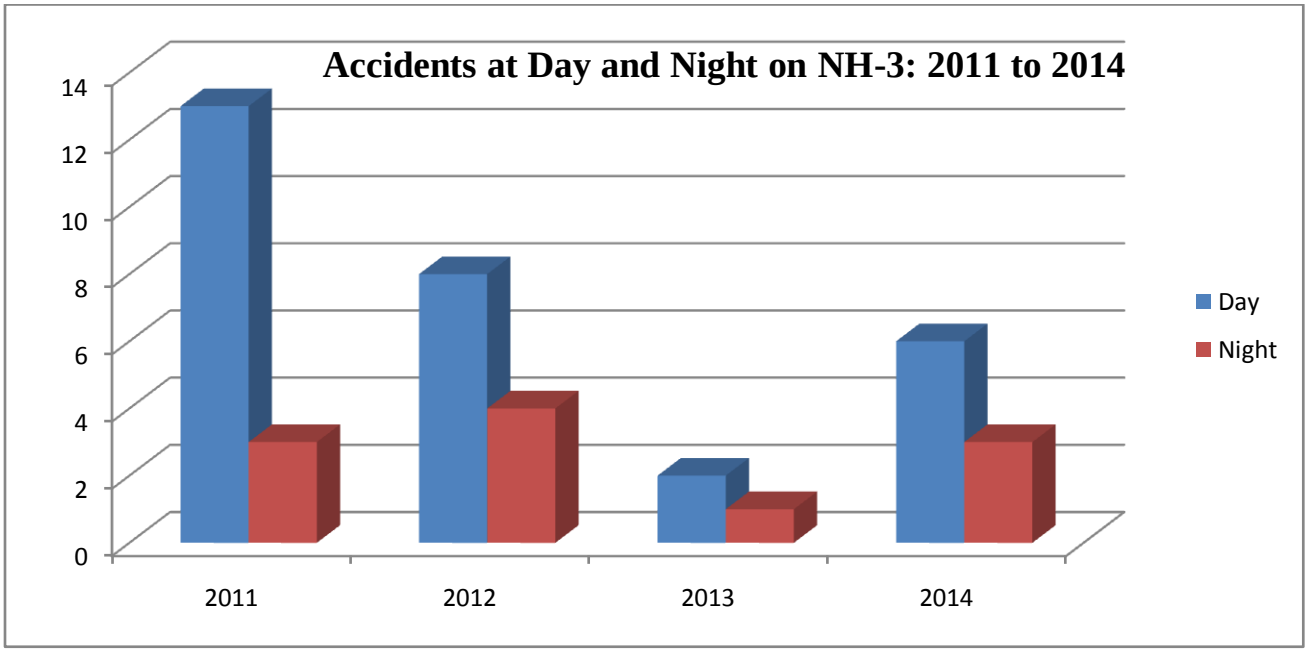


Fig 3.5: Number of Accidents at Day or Night on NH-3: 2011 to 2014.

Source: Office of the Superintendent of Police Una, Distt. Una (H.P.).

Table 3.6: Different Ages of Persons involved in Accidents on NH-3: 2011 to 2014

Age / Year	8 to 14 years	15 to 24 years	25 to 65 years	65 years & above
2011	0	9	7	0
2012	0	8	4	0
2013	0	2	1	0
2014	0	6	3	0

Source : Office of the Superintendent of Police Una, Distt. Una (H.P.).

3.4.2 Accident Density:

Accident density =A/L*T

Where A = Total number of accidents, L = length of road, T = Number of years.

Accident density = 40/29*4 = 0.34

Accident density = 0.34

3.4.3 Accident Rate per km:

R = A/L

Where A = Total number of accidents occur in one year.

L = Length of control section in km.

R = 40/29 = 1.37

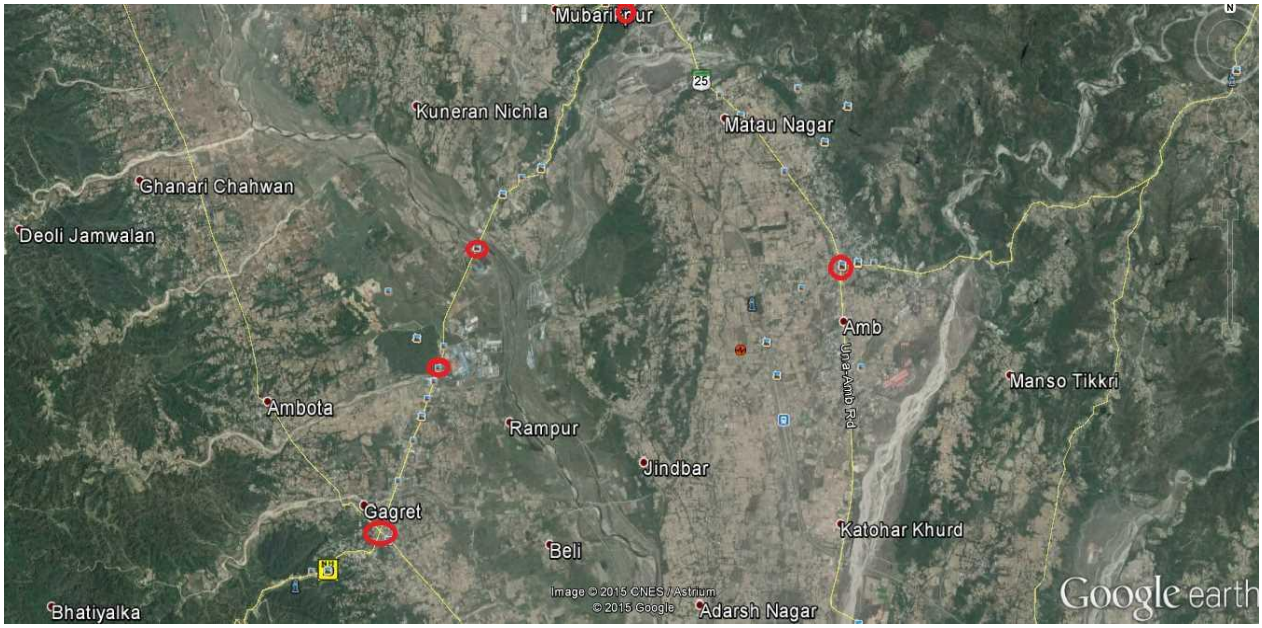
3.5 Black spots:

Table 3.7: Top ranked accident spots on NH-3 in District Una

Place	WSI Value
Near Shiv bari	82
Near Mubarakpur	68
Gagret City	59
Near Alfa Hotel	29
Amb	27

Source: Study work.

The WSI value of Shiv bari is highest so it means that Shiv bari spot is more dangerous than other spots. After that Mubarakpur, Gagret city, near Alfa hotel and in last Amb spot.



Map 3.1: Black spots on NH-3 from Gagret to Amb.
Source: Google earth.

3.6 Analysis of Primary Data:

3.6.1 Road Inventory Survey: From the road inventory survey it is observed that, the carriage way width of all stretches varies from 6 m to 8 m. But on bridges the carriageway width is 5.50 m to 6.60 m. So on some places as the carriageway width is less, is not sufficient for accommodating huge traffic and width is not satisfying the standards of national highways.

The road inventory survey is carried out in identified accident stretches on NH-3 in Gagret, Mubarakpur, Amb. Footpath, drainage facility is absent or in poor condition in the study stretches. In some stretches the shoulder is also absent and condition of road is also poor as construction work is going on.

3.6.2 Traffic Volume Count: The traffic volume count gives the measure of how many vehicles pass through a particular location during a period of time. According to the traffic volume, the time can be classified to peak hour and off peak hour. For any traffic infrastructure design and accident study peak hour traffic volume is necessary. So, in the present study, four hour traffic volume count was taken for all the spots and peak hour traffic in terms of Passenger Car Unit (PCU) was found.

From the survey it was observed that the road stretch under consideration carries mixed traffic of fast and slow moving vehicles. The highest peak hour traffic observed at Amb and lowest at Shiv bari.

Table 3.8: Traffic volume in terms of PCUs.

Accident Black Spot	Peak Hour Traffic Volume (PCU)
Amb	410
Gagret City	371
Near Mubarakpur	329
Near Alfa Hotel	283
Near Shiv bari	278

Source: Site visit survey.

3.6.3 Signage Inventory: During the signage inventory it is observed that on most of the required places the sign boards are absent like sign board before narrow bridge, right/left turn etc. and also on some places the boards are in poor conditions.

3.6.4 Speed and Delay Study: The speed and delay study was carried out by using moving observer method on entire identified black spots on NH-3 in Distt.Una to find out the average journey speed and delay of the traffic stream.

The maximum speed without delay is observe at Near Alfa hotel i.e. 47.45 km/hr and minimum at Amb i.e. 26.67 km/hr. The maximum delay is at Amb i.e. of 12seconds which is due to pedestrian crossing and no signal on junction nor the rotary is their so vehicles are moving according to themselves. The main causes of delay of these points are pedestrian crossings, parking problems etc.

Table 3.9: Speed and Delay study

Place	**Average journey speed (km/hr)**	
	Without Delay	**With Delay**
Gagret City	34.88	34.79
Near Alfa Hotel	47.45	47.42
Near Shiv bari	35.39	35.37
Near Mubarakpur	34.20	34.14
Amb	26.67	26.55

Source: Site visit survey.

Chapter 4

RESULT AND DISCUSSIONS:

4.1 Near Shiv bari : Shiv bari is identified as the most vulnerable accident stretch on NH-3 in District Una.

Fig 4.1: Shiv bari accident locations.

Source: Site visit photography.

- Identified stretch has the necessary lane width and condition of road is also good. But absence of shoulder is the main cause of accidents.
- The marking is absent on the left & right side of the road.

4.1.1 Suggestions for improvement:

Fig 4.2: Suggestions for improvement of Shiv bari location.

Source: Site visit photography.

1. Provide the shoulder of width 1.0 m on hill side and 2.0 m on valley side in Mountainous Terrain.
2. Roadway Width in Mountainous Terrain is 10.0 m (exclusive of parapets and drains).
3. Provide the guard rails on the valley side of the road.
4. Use the sign boards to inform the drivers about the turns, speed etc.
5. Proper marking on roads.
6. We can provide the roadway delineators on the valley side of the road.

4.2 Near Mubarakpur:

Fig 4.3: Near Mubarakpur (Mubarakpur - Amb Road).

Source: Site visit photography.

- This black spot is near Mubarakpur (Mubarakpur – Amb road). Here the condition of road is poor.
- Right edge of road has more height as compare to the left edge of road may be because of inadequate super elevation design.

4.2.1 Suggestions for improvement:

Fig 4.4: Suggestions for improvement for Mubarakpur accident spot.

Source: Site visit photography.

1. First of all construct the road because the condition of road is poor here.
2. Redesign the Super-elevation because here the right side is more raised as compare to the left side. Because of this the unequal pressure on the wheels of vehicles, which result from high value of sideway force between the tyres and the roadway surface. Here the super-elevation is more than 0.12. As per Indian practice the Super-elevation is limited to 0.07-0.10
3. Use the sign board on curves to inform the drivers about the curves and also speed limit sign board.
4. Provide the shoulder both side of the road.
5. Provide the road delineators.

4.3 Gagret City:

Fig 4.5: Gagret city

Source: Site visit photography.

- In the main bazaar of Gagret the width of carriageway is not according to IRC standards for NH.
- Also the shoulder is absent.
- Sight distance is poor.
- Jams also occur here.
- No space for parking.

4.3.1 Suggestions for improvement:

Fig 4.6: Suggestions for improvement for Gagret accident location.

Source: Site visit photography.

1. Provide the shoulder.
2. Because of the peoples walk on the road the sight distance is poor and also due to the shopkeepers takeover the road sides in front of their shops.
3. As there is no space available for increase the carriageway width and shoulder, we can suggest the bye-pass for this because of that the jam condition is also decrease in the main bazaar of Gagret.
4. Provide the speed limit sign board.

5. As there is no chance of providing the traffic signals, rotary, the traffic police should be there for safe movements of traffic.

6. Provide the space for parking.

4.4 Near Alfa Hotel:

Fig 4.7: Near Alfa Hotel Gagret.

Source: Site visit photography.

- This black spot point is near Alfa Hotel Gagret. Here the width of carriageway and shoulder is satisfactory.
- But on the bridge no space for pedestrians for walking.

4.4.1 Suggestions for improvement:

Fig 4.8: Suggestions for improvement for Alfa hotel accident location.

Source: Site visit photography.

1. Provide the marking on the road as well as on bridge also.
2. Speed limit sign board.
3. Before the bridge provide/install the “Narrow Bridge” sign board.
4. Provide the safety barriers just before the bridge starting on both sides of road.

4.5 Amb:

Fig 4.9: Amb city.

Source: Site visit photography.

This spot is near the bus stand and market of Amb city.

- Here the condition of road is not good but the construction work is going on here.
- No marking on the roads.
- No zebra crossings.
- No space for parking.
- Also sometimes the buses are stop on the side of road.
- On intersection of road, no rotary or signal is provided because of which the jams conditions occurs here.

4.5.1 Suggestions for improvement:

Fig 4.10: Suggestions for improvement for Amb city accident location.

Source: Site visit photography.

(1) Provide the markings on the road.

(2) Provide the zebra crossings near the bus stand and junction for safe crossing of the pedestrians.

(3) Provide the parking so that vehicles cannot be stand on the side of the road which creates the problem for pedestrians and for vehicles also.

(4) No bus should be stand on road which is the responsibility of the traffic police.

(5) Provide the rotary or signals on junction where the roads are crossing.

(6) Provide the speed limit sign boards in the city on National Highway.

Chapter 5

CONCLUSION:

The identification and analysis of accident black spots help in identifying the stretches where accidents are more and these spots reduce the road safety in general.

The spot on road where traffic accidents are frequently occurred is termed as black spots. The current study was an attempt to find out the most vulnerable accident locations or black spots on NH-3 in Distt. Una, Himachal Pradesh. The Weighted Severity Index (WSI) method was used to rank the accident locations. The top five spots were selected as black spots as per the WSI value from the collected data and suggested some possible alternative measures to improve the transportation system. The overall methodology was found to be effective for the identification, evaluation and treatment of accident black spots if sufficient data is available.

The deficiencies like non availability of parking lane, no zebra crossing, no guard rails and sign boards and also the no proper road markings and unauthorized parking and over speeding etc.

It is also observe that most of the 2-wheelers are not using the helmets and they also over speeding their vehicles.

It is also observed that this National Highway is under construction and after construction these deficiencies may be reduce.

Implementation of the suggested improvements will help to increase the overall road safety.

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