

**ACCIDENT STUDIES AND ROAD SAFETY AUDIT OF FOUR
LANE JAMMU TO UDHAMPUR SECTION OF NH-1A FROM
KM 15.200 TO KM 67.000 OF NH 1-A IN THE STATE OF
JAMMU & KASHMIR**

A Dissertation Submitted
In Partial Fulfillment of the Requirements
for the degree of

**MASTER OF ENGINEERING
IN
CIVIL INFRASTRUCTURE ENGINEERING**

Submitted by:

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UNDER THE SUPERVISION OF

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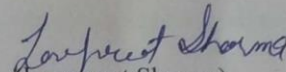


**DEPARTMENT OF CIVIL ENGINEERING
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JULY 2017**

DECLARATION

I, Lovepreet Sharma, hereby declare that this thesis titled "**Accident studies and Road safety audit of four lane Jammu to Udhampur section of NH-1A from km 15.200 to km 67.000 of NH 1-A in the state of Jammu & Kashmir**" is an authentic record of my study carried out as requirements for the award of degree of **Master of Engineering in Civil Infrastructure Engineering** in the Civil Engineering Department, Thapar University, Patiala, under the supervision of **Mr. Tanuj Chopra, Assistant Professor**, Department of Civil Engineering, Thapar University, Patiala during July 2015 to July 2017. This matter embodied in this report has not been submitted in part or full to any other university or institute for the award of any degree.

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CERTIFICATE

This is to certify that above statement made by the student concerned is correct and true to the best of my knowledge and belief.



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ABSTRACT

Road Safety Audit (RSA) is a formal procedure for assessing accident potential and safety performance of new and existing roads. Road safety audit is an efficient, cost effective and proactive approach for the improvement of road infrastructure. It has been proved that road safety audit has the potential to save lives. It is applicable at all stages of project implementation i.e. from planning stage to developing stage, detailed design, construction stage, operation and maintenance stage. Road Safety Audit is very important for the proper implementation, design, operation and maintenance for the design period of the project highway. It is very important from the safety aspects of road as well as road user. It means safer roads which means safer life.

This study deals with the collection and analysis of accident data for year 2016 of existing four lane National Highway 1 A for Jammu- Udhampur, so as to identify the areas of major concern, including black spots, accident-prone stretches on the project highway. It also involves the determination of accident severity index and rate per million of entering vehicles on the project highway. The value of Average severity index is used to calculate blackspots and the value of rate per million of entering vehicles is to calculate the number of crashes occurring at a particular location. This study also deals with the road safety review of existing four lane highway and providing various recommendations for various deficiencies that exist on the project highway. It also includes the development phase audit which involves plan and profile data checking for the four-lane highway as per IRC specifications for the safe design of horizontal and vertical curves. It provides various checklists for development phase audit from the safety aspects which is prepared as per latest MORTH specifications.

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CHAPTER 1

INTRODUCTION

1.1 General

India has an estimated of road network around 3.3 million km, which carries nearly 65 % and 85 % of the total goods and passenger transport. The share of National Highways (NH) and State Highways (SH) in the total road network is just 6 % but these cater to 70 to 75 % of total road traffic in India. However, the National Highways, which constitute less than 2 % of the total road network, account for 20 % of total road accidents and 25 % of total road traffic fatalities occurring on Indian roads. Road traffic is estimated to grow at 7-10 % while the vehicle population is growing at rate of 12 % per year. In the year 2014 (Times of India, 2015) there were 486476 road accidents which caused death of 137,572 people and a total of 494,893 people were injured (National Crime Records Bureau, NCRB in 2011). India accounts for 10% of the deaths from road crashes all over the world. The accidental deaths have shot up to 44.2% in 2011 from 31.4 % in 2001. This shows one death in every five minutes in the Indian roads. If the accidental fatality keeps on increasing at the same rate, this will increase to one death in every three minutes by the year 2020.

According to Global status report on Road Safety given by World Health Organization 2015, 1.2 million people die every year due to road crashes in the world; in addition, there are 50 million cases of serious non-fatal injuries. Road accidents are the leading cause of death to the people between the ages of 15 and 29 years. Report shows that around the world, 90% of the total road traffic deaths and injuries occurred in the low-and middle-income countries, which is almost double the fatality caused in the high-income countries. Report shows that out 49% of all road traffic deaths occur among pedestrians, cyclists and motorcyclists.

The World Health Organization 2015 report road predicted that road accidents will be the seventh leading cause of deaths by 2030. In the past five years, majority of countries have accepted the recommendations of World Report on Road Traffic in regard to prevention of injuries, which provides guidelines how countries can implement a comprehensive approach in order to improve their road safety and reduce fatalities on the roads. There report sets a target of reducing road fatalities by 50% from year 2011 to 2020.

1.2 Global scenario of Road accident

Following are the important outcomes of Global status report on road safety by World Health Organization in 2015:

1. Nearly 1.2 million people die every year due to road crashes in the world; there are nearly 50 million cases of serious non-fatal injuries.
2. Most of the fatalities are young people between the ages of 15 to 29 years
3. Control and Preventive measures cost Governments approximately 3% of the GDP.
4. Report shows 49% of all road traffic deaths occur among pedestrians, cyclists and motorcyclists.

5. It has been predicted that road accidents be seventh leading cause of death by 2030.
6. Report shows that in the world, 90% of the total road traffic deaths and injuries occurred in the low-and middle-income countries, which is almost double the fatalities caused in the high-income countries (Figure 1.1).

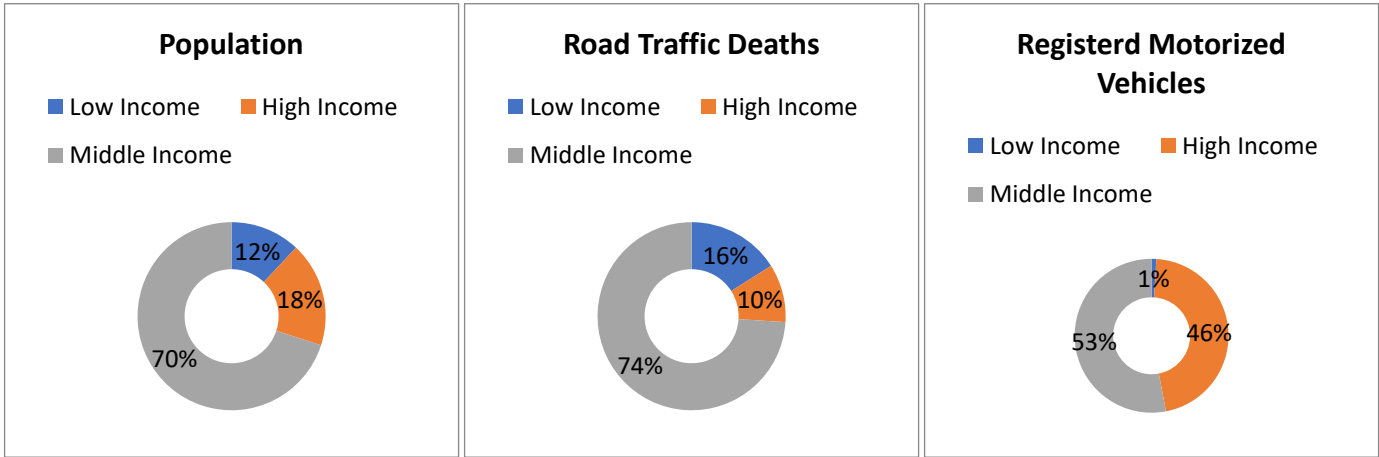


Figure1.1 Population, road traffic deaths and registered motorized vehicles, by country income status (Source: Global Status Report on Road Safety, 2015)

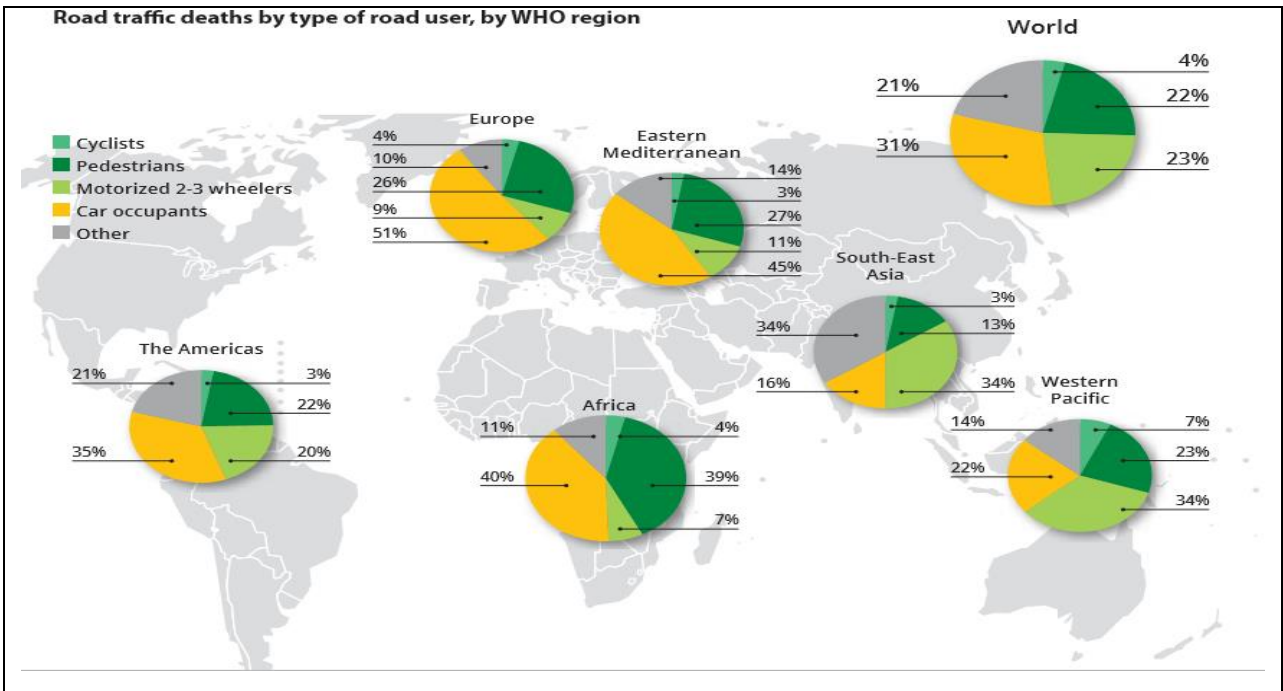


Figure 1.2 Road traffic deaths by type of road user, by WHO region
(Source: Global Status Report on Road Safety, 2015)

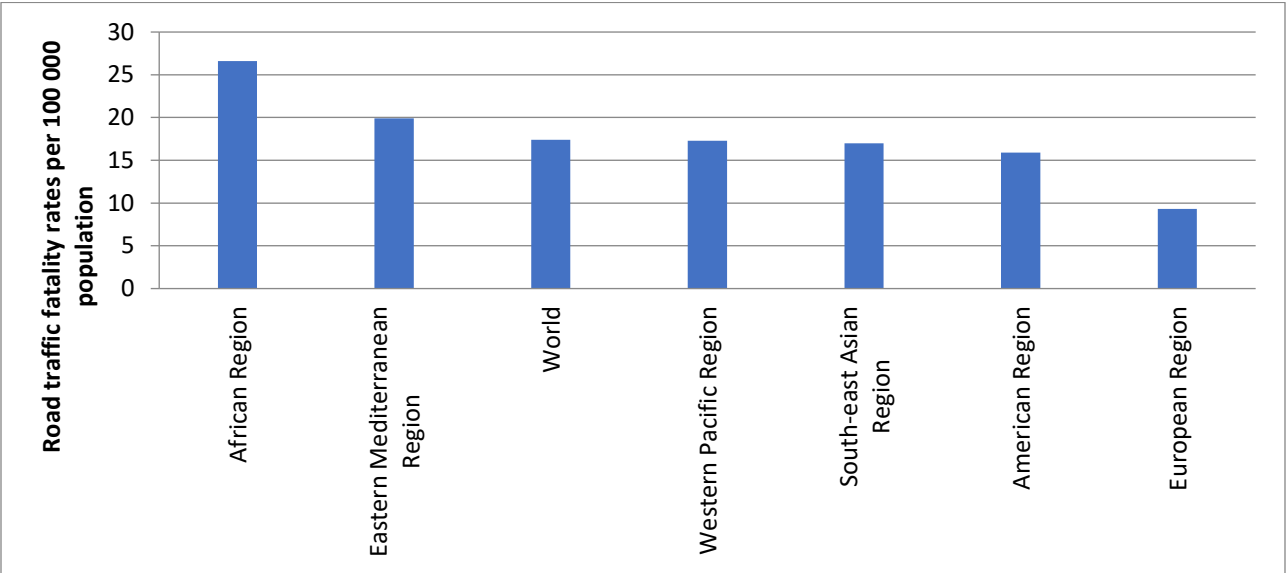


Figure 1.3 Road traffic fatality rates per 100 000 population, by WHO region
(Source: Global Status Report on Road Safety, 2015)

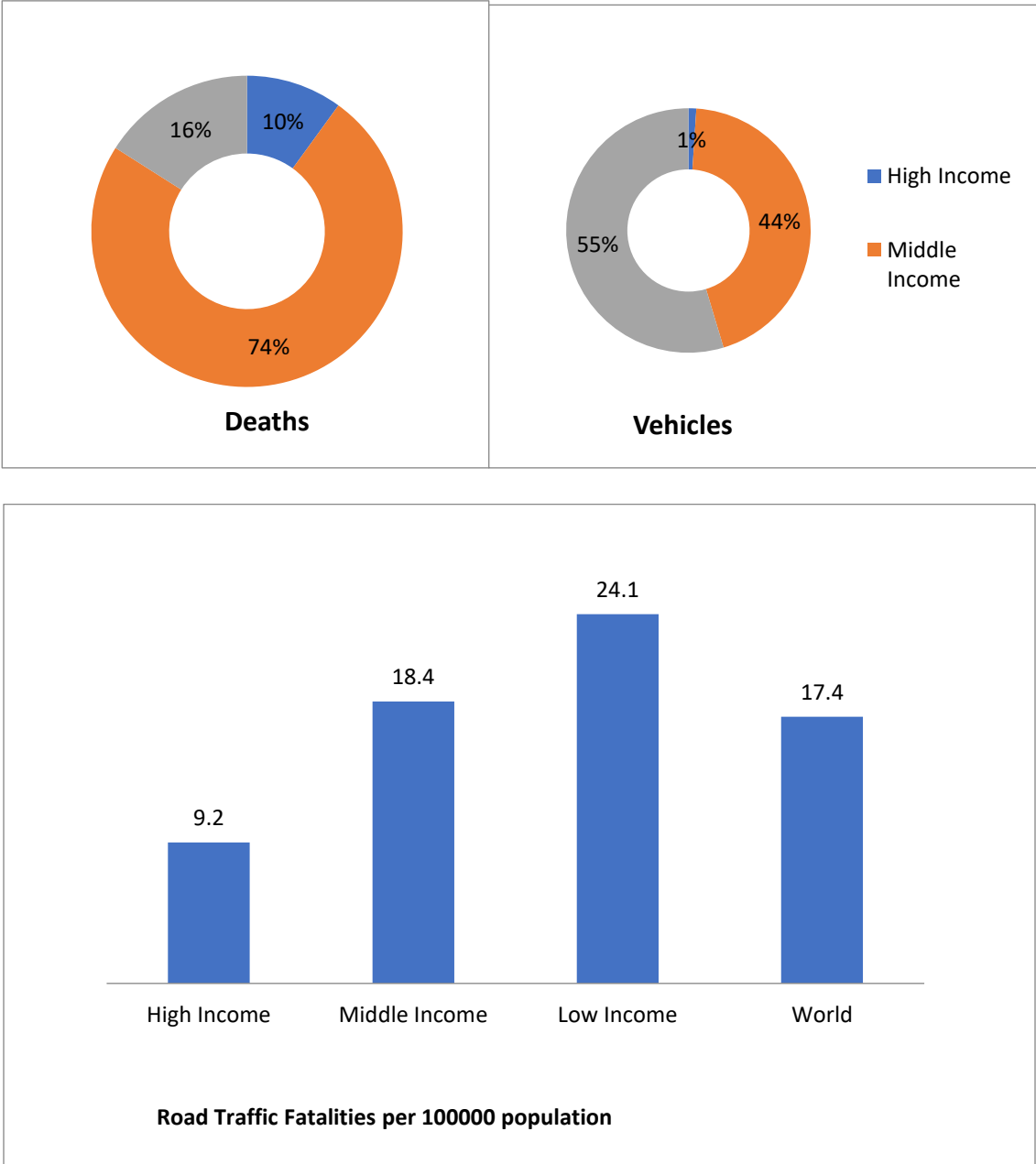


Figure 1.4 Road fatalities and vehicles contribution in low, middle and high-income countries
(Source: Global Status Report on Road Safety, 2015)

1.3 Accident scenario in India

In the year 1970 number of road fatalities less than 20,000, But at the end of 2014(As per Road Accidents in India, 2014) it reaches up to 137,572 road fatalities.

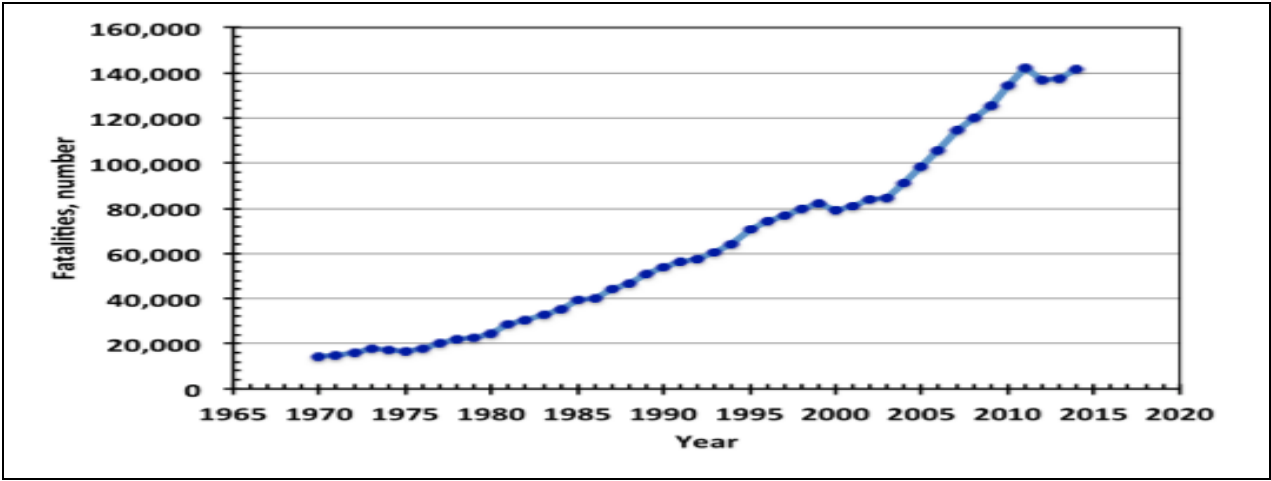


Figure 1.5 Road traffic deaths in India 1970 to 2014

(Source: NCRB)

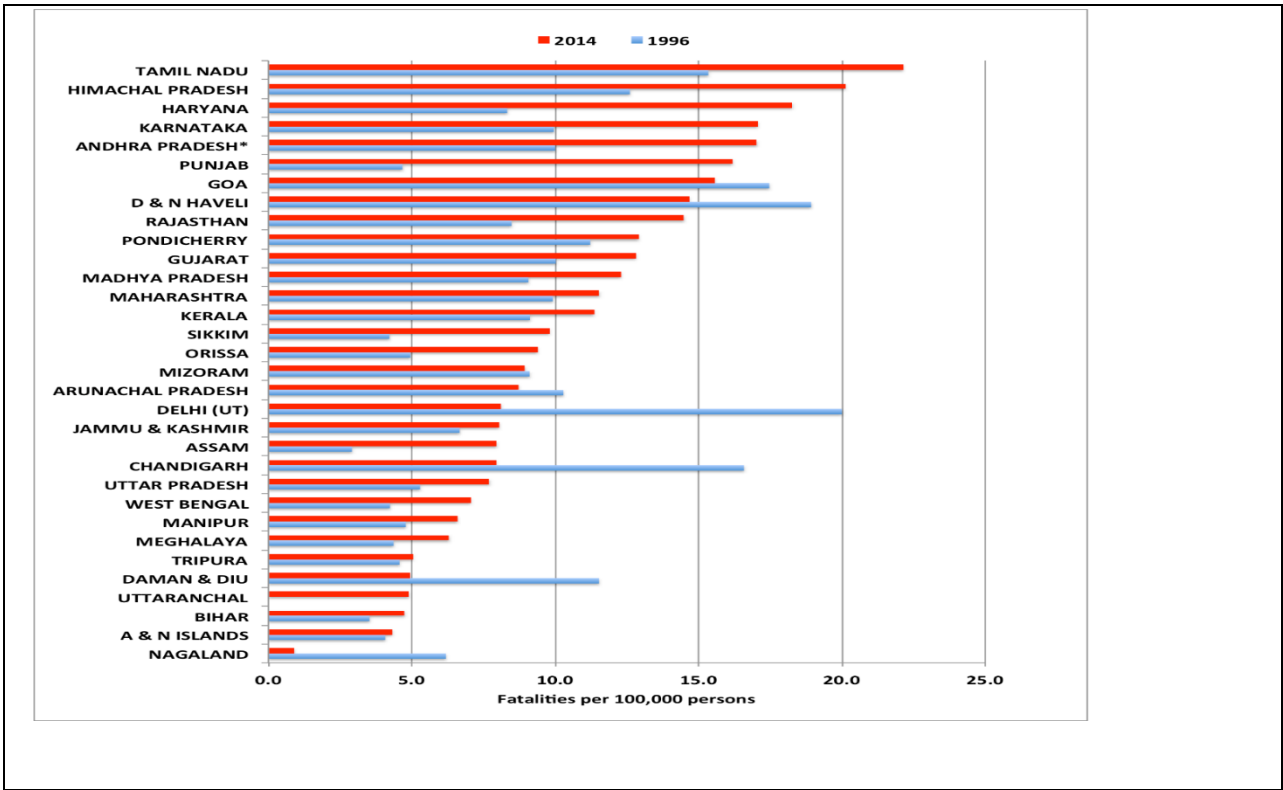


Figure 1.6 Fatalities per 100,000persons for states and union territories in 1996 and 2014

(Source NCRB).

Fig. 1.6 shows that maximum number of road fatalities per 100,000 persons in 2014 occurred in the Tamil Nadu at the end of 2014.

Fig. 1.7 shows pedestrian suffers maximum road deaths 34% among all road users.

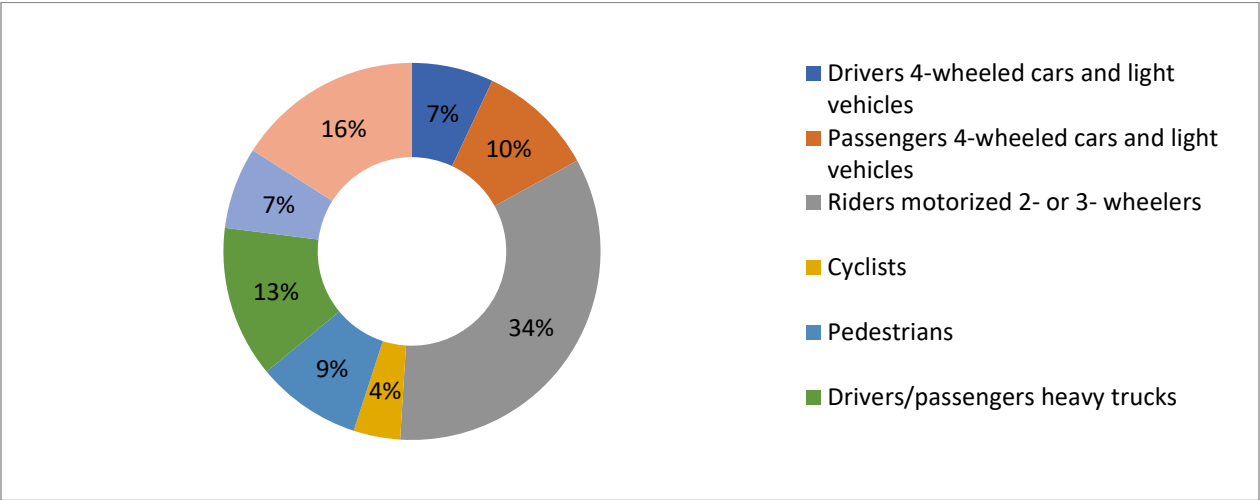


Figure 1.7 Deaths by Road user category

(Source: Global Status Report on Road Safety, 2015)

1.4 Road Safety Audit (RSA)

Road Safety Audit (RSA) started in United Kingdom in early 1980’s, then it moved to Australia and New Zealand in 1990, and in mid-1990’s it was introduced in USA. With the Publication of Austroads guidelines it reached several countries of the world. World bank makes necessary for every world bank funded project to be audited from safety point of view. (Bagi, et al 2012). In India Ministry of Road Transport and Highways sponsored the project on “Development of Safety Audit Methodology for Existing Roadway Sections” to Central Road Research Institute (CRRI) in April 2002. (Jain, et. al).

Road safety Audit is defined as the independent review of newly constructed road and existing roads by the expert independent audit team at the planning, design, construction, operation & maintenance stages of the project in order to achieve overall safety performance and accident free roads .The main aim of road safety audit team is to check dangerous features accidental potential on the highway and evaluate safety performance in the provision of new road schemes, and the improvement and rehabilitation of existing roads. The primary theme of the road safety audit is to help the project to achieve successfully the safest journeys and minimize death and serious injury on the roads. A road safety audit brings to focus all areas of the picture that otherwise stay safe from the system in the background and brings these to the auditor's attention as the drawbacks of the project.

1.4.1 Objectives of the Road Safety Audit

The following are the primary objectives of Road Safety Audit:

- 1. To minimize the accident occurrence on the project highway or anywhere else in the road network.
- 2. To minimize the accident severity on the highway with development of safe riding environment on the highway.
- 3. To Provide the best solution for roads deficiency.
- 4. To increase the awareness about the safety culture among designers who are involved in the planning, designing, construction and maintenance of road.

5. To minimize the long-term cost and clarify that unsafe design is difficult to rectify at a later stage and expensive.
6. Checking the adequacy of the proposed road furniture, appurtenances and also Checking provisions of the proposed road designs

1.4.2 Role of Different organization in Road Safety Audit

The principle of Road safety audit is independent assessment. There are three parties involved in this process, client, designer and the auditor.

Client: The road authority or body like NHAI or PWD responsible for road project which appoints a person or body to engage in design, construction or investigation of road project .it also provide necessary relevant documentation of the project. It is the responsibility of client to resolve the disagreements between designer and auditor by conducting regular meetings.

Designer: A person who is appointed by client to plan, design and supervise the construction of new road project. Designer bears the responsibility of conducting road safety audit and also essential safety measures to be considered on the basis of auditor's recommendations or client's decisions.

Auditor: A person independent from design team and with specialist expertise in road safety engineering, accident investigation and preventive traffic engineering and road design who undertake road safety audit. The Auditor carefully reviews the existing conditions which cause crash, accidents and fatalities and suggests suitable remedial measures. Auditor may comment only on safety implications and provide some constructive measure to remove accident potentials.

1.4.3. Approach and Methodology of Road Safety Audit

Road safety audit of the project road involves three stages:

Stage 1: Development phase audit

Stage 2: Construction phase audit

Stage 3: Operation and Maintenance phase audit

Stage 1: Development phase audit is the first stage of audit, which shall be carried out after the completion of preliminary design or examination of typical design aspects of the project at the draft stage. This is the last opportunity in which significant changes in the alignment of the road can be done in such a way as to avoid any disruption that may occur to the project before the next stage of the road construction begins. The most important aspects, which are covered in this stage are the following:

- Collection of the accident data or record of previous two years from nearby police stations and other case diaries.
- Complete the analysis of crashes made to calculate the no of serious and fatal accidents and non-fatal injuries and the causes of the accident.
- Identification of black spot by calculating Average severity index (ASI) and comparison of calculated value of ASI with threshold value of ASI and identify the accident-prone area and analysis of traffic volume count and their trend.

- At the Development phase, all the members of the audit team visit the highway site for highway improvement plans, to check that if any a permanent change to the existing highway layout is required. They also evaluate the features of the sites in which a new offline tie-in to the existing highway is proposed.
- At this stage road safety audit team conduct a meeting discussing various solutions and select the best possible feasible solution.
- Various seminars and workshop will be conducted to create awareness in the public about road safety measures.
- At this stage detailed design and draft report is prepared which involves various typical considerations about the proposed road such as horizontal and vertical profile of the road project, number of lanes, paved or unpaved shoulder width, the proposed cross sections of the road, intersection layouts or interchanges, proposal of road markings and signages etc.

Stage 2: At Construction phase audit is carried out when the project construction is in progress to access the safety environment around the work zone or construction zone. This is to minimize the accidental risk to road user and whether additional safety measures need to be adopted or not. This can be done by safety audit team inspecting by walking or driving on the road. The issues which were raised in the previous study will be considered at this stage. The main point of the audit discussed as follows:

- A gap report will be provided between the safety report of development phase and final safety which can be implemented at end.
- Identify the safety implications of the construction planning.
- The road safety audit at this stage is usually done at least once in every three months so as to check the adequacy of the safety measures adopted and provided in a construction zone.
- The monthly accidental data can be collected from Concessionaire and other secondary sources to investigate the cause of road crash fatalities and provide countermeasures.
- Seminars and workshop will be conducted to create awareness about the road safety to engineers, drivers and workers in the construction zone.
- Submit a quarterly report on safety audit once in every three months of year.
- The Various road for day and night control checks are carried out, to verify that the road facilities Such as lightening, roads signs, delineators and darkness related issues.

Stage 3 Operation and Maintenance phase: The audit is carried out during first year after the completion of operation and maintenance phase of project when the road opens to traffic. In this stage, road safety audit is conducted once every financial year. The main points of the audit are discussed as follows:

- Analyze and study the annual report and accidental data of preceding year and carry out inspection of project highway.
- Particular attention to be paid for any changes in design during the construction phase, such as road alignment, Road signs, intersections etc.

2.1. General

Over the past few years, various studies have been conducted on the road safety audit of various roads for the purpose of minimizing road fatalities. Road safety audit of various selected stretches has been studied by various authors. Review of the previous work done on road safety audit is explained in the following sections.

2.2 Literature Review on Road Safety Audit

Jain *et al.* (2011) conducted Road safety check for the newly-built section of four lane State Highway (NH)-58 India and focuses on the benefits originate from the project after the removal of deficiencies found during the audit. The selected study stretches from Km 75.00 to Km 130.00 of National Highway 58. The selected road stretch is the newly reconstructed and upgraded to four lanes. The most important Two points is selected area is Muzaffarnagar and Meerut highway in the State of Uttar Pradesh, India. Road inventory data for selected stretch like carriage way width, median and shoulder width, etc. Traffic volume survey conducted at the site with 15minutes ,30 min. and 1-hour time interval at location Km 75.400 on NH-58.and classified according to hourly traffic variation, peak hour traffic, average daily traffic, traffic composition and directional distribution. Average annual daily traffic will 20293 PCU. Peak hour volume of vehicles after study 1516 and peak hour be 14.00 to 15.00 P.M. Maximum vehicle composition is two-wheeler which is 23 %. Maximum daily variation of traffic is on Sunday. Spot speed survey will be conducted to calculate average speed which is 60-70 km/hr. Accidental data can be collected. From the year 2005-2010 in the nearby police station. Results shows that average speed be 60-70 km/hr. Study shows that maximum accidents occur during 2007 and then 2006. Multiple Linear Regression (MLR) Analysis method is used to calculate accident rate. During site visit different observations has been observed, Unauthorized Median Opening at Km 75.160. Minor Junction not developed at KM 76.950and at Km74.060 Drain cover not provided on 74.080 km. Median Opening at Km 77.835 Object Marker and Pavement Marking missing. Underpass at Km78.350 raised footpath not provided. Soil can be spilled at the main carriageway on various location. confusing sign board of Truck lay bay at Km 122. 400.Hazard marking and object marking missing at 121.800 km. From the study concluded that road standard is rise suddenly due to newly upgraded from 2- lane to four lanes from chainage 75.00 to130.00 km. but roads parameters and road related does not brought to this level, say Road user perception, surrounding environment etc. According design speed permitting high speed but actual traffic conditions does bring up to that level of speed. Design speed of road is 100 km/hr. Now Average speed will be 60-70km/hr. And earlier it is 30-40 km/hr. Study also noticed that slow speed moving vehicle create traffic hazard to fast moving vehicle because it occupied innermost layer. In order to that a service lane to be provided along the entire four lanes upgraded stretch. An unauthorized median opening should be closed at priority. Study shows that Road Markings, Condition of Shoulder, Spot Speed, Median Opening,

Carriageway width and Traffic Volume, are the main reasons for the accidents. Pedestrian guard rail should be provided along the footpaths, bus lay bay etc. proper arrangement of lightening and road signs and marking be provided at various intersections and all under developed bridges and junctions can be developed because majority of accident occur at such locations.

Singh et al. (2011) present the road current situations of road accident and fatalities scenario on Indian roads and provide countermeasures for various specific problems. In this study try to focus on inflammable issue like road accidents, their trends, factors responsible for road accidents, adverse effects of road accidents, prevention and control and some recent approaches to improve the safety on roads. with the rise of population and drastic change in the lifestyle of middle class people in last two decades. Movement of people towards cities results the increase in the traffic demand. which creates a difference of demand and supply causing a safety challenges on roads. Approximately 9500 people died on Indian roads annually and 260 people died daily. Around 3% loss of GDP every year. Experts researched that the ratio of accidents deaths, injury requiring hospital aid and, minor injury. which show 8% peoples directly affected by accidents. In 1970's only 12% died in accidents but as compare in 2004 it reaches 21.4 %. In spite of large development in road infrastructure, designing, planning etc. The cause behind the accidents is over speeding, lack of driver's ethics, road design and traffic violation. Accident top leading cause of death between the age of 5 to 44 yr. Death. The projected 40% increase in global deaths b/w 2002-2030. The report says without any increase in efforts there will rise in 65% accidents deaths and injuries b/w 2002-2020 but in middle and low-income countries it is increased up to 80%. In such countries majority of deaths were due to pedestrians, cyclists, motorcyclists and vulnerable road user. On the other hand, in high income countries death cause by car more predominantly but the risk factor of vulnerable road user is more. Road safety is multisectoral and multidimensional problem. This includes the development and maintenance of road infrastructure, improve legislation and law enforcement, safer vehicles, the planning, the provision of services in the health and safety of children in hospitals, on land-use planning, etc. The above data, we can say that road safety is a critical and difficult problem in today's scenario, the Government of India and the roads would be to start thinking very seriously is the combustible problem. Countries are facing various crises and the loss due to the reduction in road safety. However, the only record of the long-term solution to the problems of road accident. Provide high quality divided road have better performance than un divided highway. Particular measures have been adopted to reduce speed in urban areas because vulnerable road user more susceptible to fatality due to high speed even also at when the vehicle on moderate speed. this reduces the large no of road fatality. experience shows that 32% reduces in death with the reduction in speed up to 50 km/hr. in Hungary and with priority cost effective measures have to made to accidental problem.

Patel et al. (2012) conducted a road safety audit of SH-83 and SH-188 which is important state highways in the state of Gujarat which further connects NH-8. SH-83 and SH-188 are interconnected to each other starting from Umreth to Sarsa (SH -83), Umreth to Tarapur (72 km) and Sarsa to Vasad (SH-188) 10 KM long. The selected study stretch for safety audit is 29 km. the objective of the study to know cause of accident, land use pattern and blackspots of the study area. Road inventory be collected by conducting surveys to identify width of carriageway, shoulder

width, Median facility, land use pattern along the selected stretch. Classified volume count survey be carried by manual methods, photographic methods combination of manual and mechanical method and Automatic counters on weekly basis at Umreth and Vasad junction. study shows that two-wheel and car are more in number due to high income of people residing along road share of two-wheel vehicle is 29.83%. highest among all than other vehicles, cars, three wheelers, jeep as 26.62%. Accident data from year (2006-2012) collected from three different police stations. and classified according to hourly traffic variation, peak hour traffic, average daily traffic, traffic composition, vehicle type and road user type. study shows that total 250 accidents occur on selected stretch, out of which fatal 57, serious 48 and minor 145. Two-wheel cars and three-wheeler are main responsible of 74% accidents. and covers 75% of total traffic on the study area. 67% of accidents occurs between 8.00 AM to 6.00 PM during day time and 33% accidents occur during 6.00 PM to 8.00 AM. Max accidents occurred in month of May during summer season. Study also shows that 38% accidents occur due to head on collision, 23% pedestrians hitting by vehicle and 15% due to side swipe. 85% accidents are occurring when the vehicles are moving on straight road this is because poor road geometry. According to accident spot type 38% 23% and 22% on straight road, T-junctions and cross roads. 93% accidents occur due to driver error. In remedial measures need of road making and signs, speed breakers, median at the center of road to separate traffic on both sides and island at Kanpur- intersection, Vasad and Umreth junctions. Roundabout Circle be provided at the middle of cross road at Ahima crossroad and proper sight distance be provided by removing unnecessary objects. From above analysis, it may have concluded that more accident occurring during day time as compared to night time. Poor road geometry, lack of sense of safety, Lack of traffic sense contributing to road accidents.

Bagi et al. (2012) conducted a road safety audit Bannerghatta road (SH 87) of 12 km. audit can be done from four-year data. The objective of analysis identifies accident black spots from FIR, effect of road geometrics and traffic on the road stretch and developed a statistical relationship between various factors causing accidents and crash rates. Road inventory data collected by sub dividing stretch each of 1000 m. Volume count at two locations for covering both peak hour and off-peak hours of day. To calculate speed of every kilometer floating car method be used. The selected stretch is 12 km long from Mico layout bus stop to Bannerghatta village. Accidental data of four collected from concerned police station. form database as per IRC to collect necessary information such as date, time, weather conditions, accident location, vehicle damage and road severity and nature of accident. Accident data will have arranged kilometer-wise, hour-wise, month-wise and year wise to identify black spots. As per km-wise data distribution shows that 60% accidents occur between 1 to 4 kilometer. Study shows that pedestrian safety is very low on selected stretch. Gopallan mall opposite pedestrian crossing major accident spot. out of total 217 accidents pedestrians involves 88 accidents. The main reasons behind that presence tree on median which create sight problem, speed of vehicles, inadequate shoulder and footpath width. various graphical relation be developed between accidental rates and different width of roads like carriage way, shoulder means if width of road increased it is enough provide space for parking the vehicles, for crossing and overtaking the vehicles. To find accident rate Barkov's partially severity factors to be used. With help of accident data, road geometrics data and traffic characteristics, from the above

study it was concluded most no of accident occurs during 2011. safe stopping distance and overtaking sight distance can be the most important factor for reducing accidents.

Mishra *et al.* (2013) carried out safety audit of to identify the locations on the NH-22 between Shimla and Solan to identify accident black spot, investigate cause of accidents and provide countermeasures. The total road length between Solan and Shimla is 50.507 Km with about 23.007 km (46%) of the total stretch in Solan district and the remaining 27.50 km (54%) in Shimla district. The methodology used for auditing site visit takes various reading of levels by Auto levels, Total stations. Blackspots. on the selected study stretch from the data collected from various responsible authorities. Accidental data of past 10 years collected of selected stretch from concerned police stations. Majority of the accident occurs. more no of vehicles involved in the accidents and no of people killed in the year 2007. Analysis shows that more 3000 cases registered 4100 people vehicles involving in the accident and cause 780 deaths and more than 5500 serious injuries within 10 year (2003-2013) Geometric analysis shows that if 10 km/hr. decrease the speed on stretch the safe stopping sight distance can be increased up to 83% which can reduce the accident fatalities and length of curvature within the permissible limits. The reasons for high accident rush driving, narrow curves, poor visibility, rain and snowfall and heavier traffic at night time. lack of signboards, convex mirrors, retaining walls and light poles at critical spots. Recommendations to be provided that convex mirror and signboard, light poles, and retaining walls to be provided at blind spot and sharp curves.

Sayed *et al.* (2013) studied that all the traditional method used for road safety audit are effective but more time consuming. In this study researcher used the application of geographical positioning system (GIS) to carried out the road safety audit and used GIS based software 'Gram++. This technique gave comfort to auditor to differentiate higher accident frequency rate area with the low accident rate area at different road section of road which to be improved with cost effective manner. This provide comfort to road auditor to identify deficiency and directly focus on real problems of particular road section. The main aim of the study is to minimize road fatality and their adversity. To meet the need of road user perceptions. To reduce the long-term cost of the project. To increase the awareness of safety culture in designing, planning, construction and maintenance of road. A National Highway (NH) 17 b/w Panvel and Indapur of 3 km long stretch to be carried out study of road safety audit. All the possible parameters of road highlighted on the software Gram++. Digitization of components of roads such as super elevation, positions of sign boards and chainages in raster analysis module. The analysis of the module is done and the digitization of the road, and after all the layers corresponding to the minimum distance of the snap was completed, and the polygons, the table was made. If the polygons, the table was made and tagged, then all of the new features such as the radius of the curve, the length of the road section, change the super elevation etc. was added to the table with vector analysis module, which created a database by using the layer. After the creation of the database, he illustrated the various queries such as the rise of the super < 5% and passages, which had a radius of 5000 m. He concluded that the large number of accidents can be avoided before they occur, and it helps to analyze the layer of the segments simultaneously so that the recommendations made in the initial stages can be applied to road safety in the successive stages so that improvements can be made.

Damodariya et al. (2014) carried out the study to analyze the traffic safety situation Kapurai - Dabhoi Section of SH-11, Gujarat, India and to identify deficiency of selected stretch which cause crash fatalities and provide a suitable recommendations and countermeasures for stretches. The selected stretch having length 25.8 km having heavily traffic which is further connect to NH-8. Accidental collected from 2009 to 2013 nearby concerned police station and create a database by year -wise, month wise, day -wise, km-wise accident record. This database provide comfort to auditor to find out accidental black spot. study shows that their total no of 505 crashes occur during 2009 to 2013.out of which 106 fatal,208 serious and 191 minor injuries. More number of accidents occur in the month of July. Study shows that maximum accidents occur during day time between 15.00 to 16.00 PM. Maximum tendency of accident when person going to job (morning 8-11) and after leaving the job during evening 17.00 to 20.00 PM. Maximum accident occurred due to two-wheeler, four-wheeler and trucks. Having number of accident 126,127 and 100 out of total 505. Persons lies between age limits 20-30 and 30-40 are more involved in accidents. from the above given database blackspots are calculated at place where more number of accidents occur more. It was concluded that more accidents are occur during day time than night time., due to heavy road traffic, poor road geometry and environment, lack of traffic sense and enforcement measures village road junctions ,monsoon weather contribute to accident crashes .Different recommendation are given for different deficiency found during site visit .which is at some shoulder will be provided emergency park vehicle on road side hence cause accident, hoardings are removed at chainage 2.60 km which disturb the sight distance. Zebra crossing will be provided at bus bays for pedestrian facility. Many accidents occur near railway station and bus stands on SH-11 provide speed breakers to control speed. lightening will be provided during night time at pedestrian crossing. Road marking and road sign board be provided road side, junctions and intersection.

Vaidehi et al. (2014) carried out the study road safety shows that the current transportation system is minimize the distances, but at the same time increased the risk of life. Countries such as India the accident rate increases year-on-year. The paper, with two objectives, first is a road safety audit to reduce the vulnerability of the urban area of the main corridor, and develop the random model takes an accident is the main parameter. These black spots have been determined in accordance with the objectives of the detail of the accident to stretch is selected. This study is the selected area onto the Naroda-Narol, Ahmedabad in Gujarat state the country road in the city. The primary objective of the study is to carried out road safety on selected stretch and give remedial measures to reduce accidents for study stretch. And developed an accidental model for urban areas. survey was carried out to collected accident data from five zonal police stations i.e. 2009-2013 There are 58 no of fatal accident, 310 major accident and 90 minor accident. Traffic volume carried out at different locations i.e. Narol circle, Isanpur cross road, Ghodasar cross road, Expressway Tran Rasta, CTM cross road, CTM cross road by manual count method and intersections carried with videography method. To compare Design speed with actual speed, a spot speed survey at various locations with radar gun. The observations from the survey shows that no signal be provided at five intersections, no service and parking lane be provided at Ghodasar to Jasodanagar road. Road side parking of autos on selected stretch results congestion which further leads to accidents.

Improper pedestrian's facilities and poor knowledge of rules. 50% accidents are occurred during night time. Clear weather says summer season prone to be more accidents than in winter season. unauthorized vendors are observed at Isanpur and CTM cross road. The five different locations selected as black spots based on accident data collected from police stations. These locations are Narol circle, Expressway Tran Rasta and CTM cross road, Isanpur cross road, Ghodasar. After study, black spots some points have been observed. There is no provision of service lane and parking lane from Jasodanagar road to Ghodasar. Heavy volume parked on road side create congestion of traffic. Improper pedestrian facility and poor traffic knowledge may cause pedestrian victim. Most of the accidents are occurred during night time due to clear weather, which leads to high speed. 50% accidents occurred during night. i.e. peak hours between 7:00 pm to 6:00 am and 12:00 pm to 6:00 pm. The remedial measures given above observations. Vendors are removed along the road side. Proper Zebra crossing and foot bridge to be constructed along the road. Provide proper parking along stretch. Proper signals to be provided to aware drivers. Proper sight distance to be provided i.e. removed hoarding along the road. Training Should be provided to aware safe driving. From the above study, some conclusion has been drawn the black spots are identified based on police record, deficiencies of geometric like Non-availability of footpath, service lane, parking lane etc. other parameter like absence of traffic police, not working traffic signal, unauthorized parking at intersection, Advertisement board at intersection, Non-Availability of speed breaker, improper zebra crossing, etc.

Mankar et al. (2014) carried out study that road safety audit is an important part of the transportation planning process. Because by the year 2020 road accidents become the six-leading cause of the world's largest causes of death. safety measures now included in the transport planning process and also including at design, construction, operation, maintenance and analysis, which is significantly affects traffic safety. The study shall be presented to the audit of road vehicles, communications, design, construction, operation, maintenance, and analysis of the different accident occur in the path. The main objective of the study is minimizing the accidents rate in future after the result of new infrastructure schemes and planning decisions. reducing long term cost and minimize the severity of accidents. The stretch selected for study is Nagpur city from Sitabuldi to Butibori for analysis. The road is newly constructed and upgraded and maintained and operated by National Highway Authority of India (NHAI) under the Ministry of Road Transport and Highways (MOR&TH). The accident data collected from nearby police stations of four years from 1/1/2010 to 31/12/2013. The study shows that maximum no of accidents occur in the year 2013 which is 344. Which is increasing every year from 2010 to 2013. Accident data can be classified on the basis of traffic flow variation day time and evening time and different days wise. The growth rate of motor vehicles is directly proportional to growth of different sectors like mining, agriculture, industries etc. The growth rate can be calculated mainly growth rate in per capita income, population of the selected area and GDP of the state. As the traffic increases and no of accidents also increased, study also shows no of vehicles out of control also increases. Which is results of high speed. Spot speed survey conducted on 12 October 2013 by using Video graphic method to carry out the study. The results concluded from the study that road standard is rise suddenly but other related factors does not up to that level. The speed of highway is very high. but

prevailing conditions does support that speed. The road standards have been suddenly raised. But other related factors are not brought to this level such as road user prevailing surrounding conditions, etc. The road standards are permitting high speeds, but prevailing traffic conditions are not conducive to such speeds. From data analysis, it found that Spot Speed, Traffic Volume, Road Markings, Condition of Shoulder, Median Opening and Carriageway condition were main parameters for causing accidents. And also noticed that slow moving traffics were creating hazards for fast moving traffic as it always occupied the innermost lane of highway. To reduce congestion there is provision of flyover, increase in road width, Provision of road parking signals can be provided. Or heavy traffic can be diverted to Nagpur to Wardha road. Speed of vehicles must be reduced, condition of street lightning should be improved and for minimizing accidents. Conducting traffic safety program, Travel time studies need to be repeated periodically, Traffic management and traffic operation schemes should be adopted to increase safe flow patterns.

Vanjari *et al.* (2017) carried out the safety audit study of the selected stretch service road adjacent to National Highway 3 passing through Nashik city. The stretch to be select from Adgaon Naka to Garware point. The objective of the study road safety and identify the black spots and safety concerns on the selected stretch. Analyze the accident data from the year 2010 to 2015 and discuss the results and discussion. NH3 is busy road in selected stretch and having mixed traffic condition. The classified volume count can be measured from 8 am to 10 pm. The survey can be conducted manually on daily basis selected stretch. The highest traffic volume at Dwarka circle is 13786. Dwarka circle is the Centre of Nasik City. Garware is away from the city having less traffic volume count. The traffic data from 2010 to 2015 is collected from police station & National Highway Authority India (NHAI) for the stretch of study area. The collected classified on the basis of Road user type, accidents on the basis of time of accident, on accidents on the basis of Vehicle maneuver, accidents on the basis of causes of accidents, accidents on the basis of Month, accidents on the basis of Vehicle type, accidents on the basis of Nature of accident, accidents, accidents on the basis of location and the yearly distribution of accident data. The highest number of accidents occurred in the month 2010, but the rate of accidents decreased up to year 2013. Two wheelers causes highest road fatalities i.e. 73 dues to commercial area around the stretch and minimum accidents occurred due to multi axle. i.e. 11. The more number of accidents occurred in the time interval 8 am to 8 pm. The more number of accidents occurred in the month of July i.e. 13.84%. due to rainy season and minimum number in the month of May due to dry weather and clear visibility. The more in number of occurred accidents from Mumbai Naka to Pathardi phata i.e. 28%. As these pints are entry & exit points to the flyover from service roads. The blackspots can be calculated of the selected stretch by visual observations. From the study, it can be concluded that .at Jatra hotel junction, Rasbihari cross road & Amrutdham ring road crosses the service road. This point mixed the traffic and traffic gets jammed. To avoid this underpass and flyover be provided. Speed breakers should be provided to reduce speed. At points where turns are blind provided signals and proper sight distance be provided. The unauthorized opening should be closed. signals can be provided to regulate traffic and prevent jams. From the analysis, it is concluded that more accidents occurred during day time and factors contribute to the accidents are

mixed traffic, disobedience of traffic rules & regulations, climatic conditions, poor road geometry, lack of traffic sense, habits& negligence of driver.

2.3 Gap in Study

Previous research work doesn't include plan and profile checking of alignment. Most of authors doesn't use the concept of average severity index to calculate blackspots. There is not much research that has been studied on the selected stretch NH 1A, but in my work the analysis of black spots is done thoroughly. Average Severity Index and the factors that are affecting the road safety were identified at the time of site visit and for that recommendations were made.

2.4. Objective of Thesis

- To collect the accident data of previous year and classified the collected data in order to know the Nature of accident, Cause of accident, Type of collision, Type of vehicle involved in the accident, Hourly classification number of accidents, Month wise distribution of accidents and also Month wise nature of accidents.
- To identify the black spots with Average severity index(ASI) and determination of RMEV of the project highway.
- Site field survey be conducted for road safety review and recommendations made for major black spots and points of safety concern involved in the project highway.
- To conduct development phase audit which involves plan and profile checking i.e. checking of vertical and horizontal alignment for the proposed four lane highway.
- Various checklists for development phase audit and construction phase audit have been prepared as per the latest MORTH specifications.

2.5. Outline of Thesis

The thesis has been divided into seven chapters:

- Chapter-1 consists of general introduction to Road Safety Audit.
- Chapter-2 presents a review of literature about the road safety audit conducted on various stretches.
- Chapter-3 is about the project description of the selected stretch Jammu-Udhampur NH-1A.
- Chapter-4 deals with the accident data collection and analysis.
- Chapter-5 deals about the road safety review of existing four lane highway.
- Chapter-6 is about the calculation of horizontal and vertical alignment at development phase audit.
- Chapter-7 gives the conclusion of the study and recommendations for future research.

PROJECT DESCRIPTION

3.1. General

The existing road was initially built as district road by PWD and later converted into National Highway. This road has poor geometry which does not meet with the desired design standards for National Highways. National Highways Authority of India (NHAI) under Govt. of India (GOI) through Ministry of Road Transport & Highways (MORTH) is contemplating to enhance the traffic capacity and safety for efficient transshipment of goods as well as passenger traffic on the heavily trafficked National Highway sections. GOI has entrusted NHAI with the responsibility of improving the quality of highways of national importance. The existing alignment, Jammu to Udhampur on NH 1A is a two-lane road of width of about 7.0 m and runs through rolling and mountainous terrain. The proposed project alignment starts at Km 15.200 of Jammu Bypass and ends at km 67.00 of NH-1A Main Road. The alignment starts from Sidra & passes through Nagrota check post, Nagrota Bypass, Jagti, Ban Talaab, Nandini, Suketar, Domail, Jhajjar kotli, Tikri Mand, Phalata Garnai, Udhampur Bypass and ends Jakhain after passing through village Battal Balian and Shajalta.

3.2. Project Details

3.2.1. Details of different sections of the project highway with chainage are shown in the table3.1 below:

Table 3.1 Details of section

Section Description	Chainage		Length
	From	To	Km
Jammu Bypass	15.200	20.300	5.100
Main Road	9.350	9+900	0.550
Nagrota Bypass	9+900	21+780	11.880
Main Road	21+780	50+330	28.550
Realignment of Udhampur Bypass.	50+330	52+467	2.137
Udhampur Bypass	0.000	16.362	16.362
Total Length			64.579 Km's

3.2.2. Location Map of project highway.

Fig. 3.1 shows the location map of Jammu-Udhampur Section NH-1A.

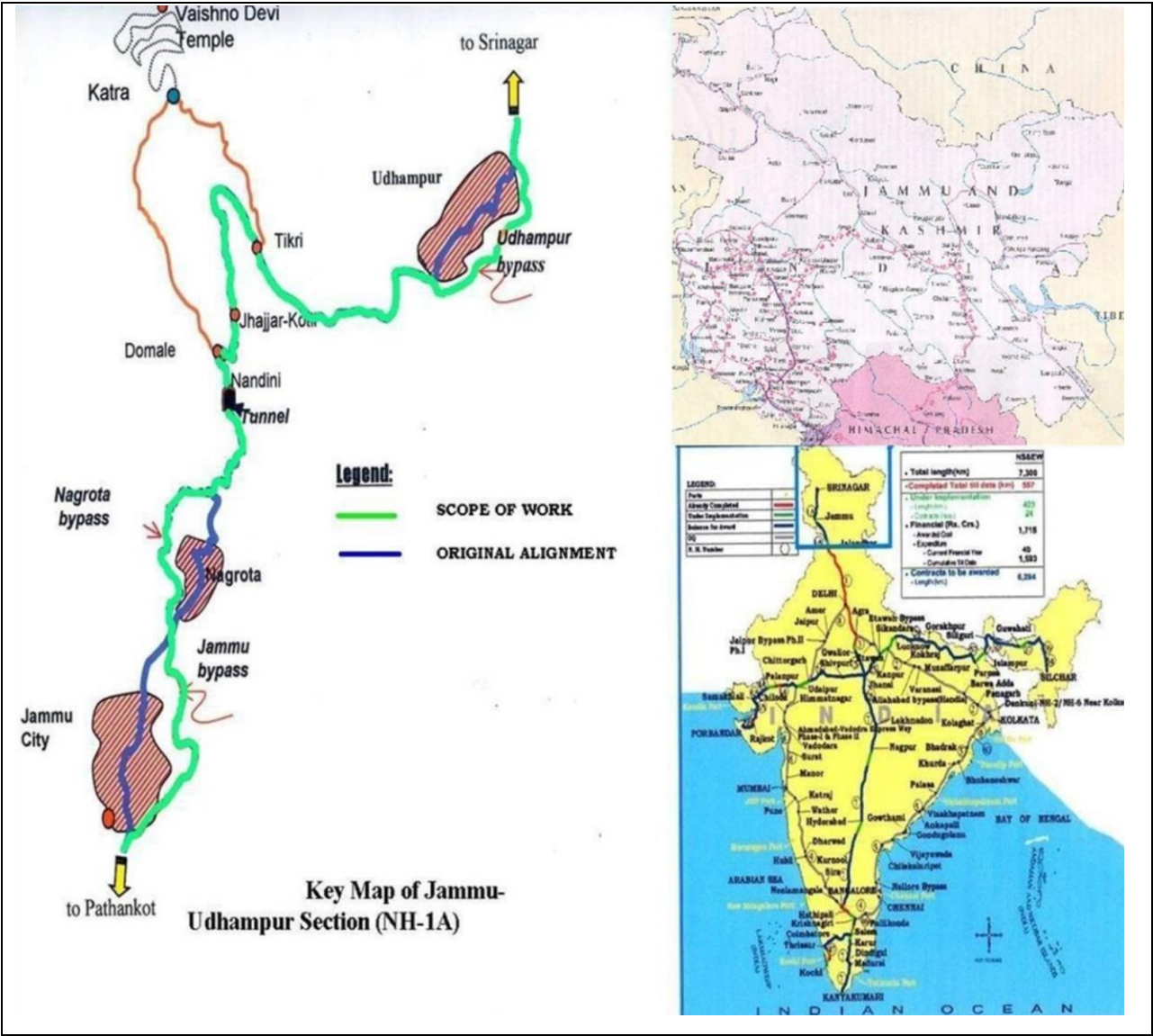


Figure 3.1 Location Map

Source: Concessionaire contract agreement.

Fig. 3.2 shows the location map of Jammu-Udhampur Section NH-1A and also comprises of chainage wise existing alignment and new alignment of projected highway NH -1A.

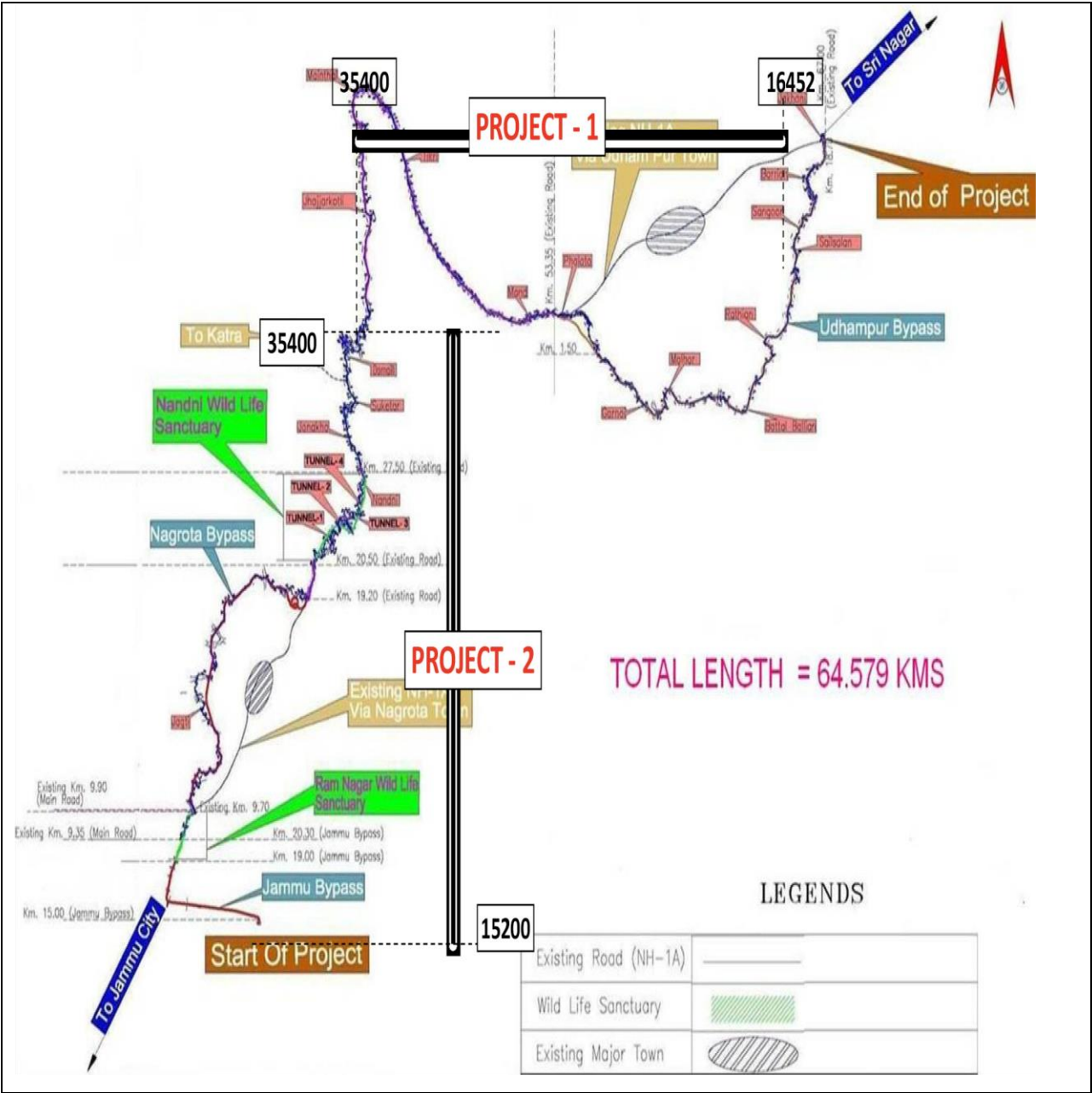


Figure 3.2 Index Map of Jammu-Udhampur Section NH-1A

Source: Concessionaire contract agreement.

3.2.3. The Site of the Project Highway comprises the land described below (as per Concessionaire contract agreement as following Table 3.2

Table3.2 Chainage-wise existing Land

S. No	Existing Chainage		Total Row (In m)	Remarks
	From	To		
1	15+000	17+000	61.000	Jammu Bypass(sidhra)
2	17+000	19+000	61.000	Jammu Bypass(sidhra)
3	19+000	20+150/9+200	61.000	Jammu Bypass (Ram Nager wild life sanctuary)
4	9+200	9+740	12.200	Jammu Bypass (Ram Nager wild life sanctuary)
5	9+740	9+980	12.200	Main Road

6	9+980	12+000	30.000	Nagrota by pass (Kanpur Nagrota)
7	12+000	14+045	30.000	Nagrota by pass (Kamini /jagti)
8	14+045	16+500	Realignment	Nagrota by pass
9	16+500	18+000	30.000	Nagrota by pass(jagti)
10	18+000	20+000	30.000	Nagrota by pass(Dhammi)
11	20+000	22+070	30.000	Nagrota by pass (Panj Grain)
12	22+070	24+300/19+260	30.000	Nagrota by pass(Ban)
13	19+260	20+400	12.200	Nagrota by pass(Ban)
14	20+000	22+000	Realignment	Main road (Ban)
15	22+000	27+160	Realignment	Main road(Janaka)
16	27+160	30+800	12.200	Main road (suketar/Domail)
17	30+800	34+700	Realignment	Main road (Daymi/jhajjar kotli)
18	34+700	37+400	12.200	Main road (jhajjar kotli)
19	37+400	38+400	12.200 (Realignment for 2-lane &Existing 2-lane)	Main road(Mand)
20	38+400	42+000	12.200	Main road(Mand/Mainthal)
21	42+000	44+000	12.200	Main road (Mand/ Tikri)
22	44+000	53+350	12.200	Main road(Mand)
23	53+350 (Main Road)	1+500 (Udhampur bypass)	Realignment	Main road/Udhampur by pass(Garnai)
24	1+500	4+400	24.400	Udhampur Bypass(Garnai)
25	4+000	8+000	24.400	Udhampur Bypass (Mallad)
26	8+000	11+000	24.400	Udhampur Bypass (Ballian)
27	11+000	14+000	24.400	Udhampur Bypass (Rathian)
28	14+000	15+000	24.400	Udhampur Bypass (Karlai khalki/Sial Salaan)
29	15+000	17+000	24.400	Udhampur Bypass(Sagoor/Niwah)
30	17+000	18+000	24.400	Udhampur Bypass(Barrian/Shajalta)
31	18+0	18+700	36.400	Udhampur Bypass (Jakhain)

The details of the proposed ROW as per the Concessionaire Agreement are given in the following Table 3.3.

Table 3.3 Details of Proposed ROW

S. No.	Existing Chainage		Design Chainage		Section	Proposed ROW in meters
	From	To	From	To		
1	15+000	20+000	15+200	20+000	Jammu Bypass	60.000
2	20+000	21+140 / 9+180	20+000	20+140 / 9+180	Jammu Bypass/ Main Road	60.000 to 92.000
3	20+140 / 9+180	20+280 / 9+320	20+140 / 9+180	20+280 / 9+320	Jammu Bypass/ Main Road	92.000 to 60.000
4	9+320	10+000	9+320	9+987	Main Road	60.000
5	10+000	24+300 / 19+180	9+987	21+780 / 19+180	Nagrota Bypass / Main Road	60.000
6	19+180	19+440	21+780	22+040	Main Road	60.000 / 44.000 / 40.000
7	19+440	19+560	22+040	22+160	Main Road	40.000 / 60.000
8	19+560	New	22+160	26+100	Main Road	60.000
9	New	26+600	26+100	26+300	Main Road	60.000 / 45.000
10	26+600	29+040	26+300	28+700	Main Road	45.000
11	29+040 Realignment t	34+500 Realignment t	28+700	32+560	Main Road	45.000
12	34+500 Realignment t	34+700 Realignment t	32+560	32+800	Main Road	25.000
13	34+700	37+200	32+800	35+200	Main Road	45.000
14	37+200	38+420	35+200	36+240	Main Road	30.000 + 30.000 (Two Separate Lanes)

S. No.	Existing Chainage		Design Chainage		Section	Proposed ROW in meters
	From	To	From	To		
15	38+420	40+260	36+240	38+000	Main Road	45.000
16	40+260	Realignment t 40+960	38+000	38+540	Main Road	45.000
17	40+960	41+200	38+540	38+770	Main Road	45.000
18	41+200	41+700	38+770	39+170	Main Road	30.000 + 30.000 (Two Separate Lanes)
19	4+1+700	41+950	39+170	39+350	Main Road	60.000 / 45.000
20	41+950	53+350	39+350	50+330	Main Road	45.000
21	53+350	Realignment t km 1+500 (Udhampur Bypass)	50+330	52+377 / 0+000	Realignment Udhampur Bypass	60.000
22	1+500	6+180	52+377 / 0+000	4+395	Udhampur Bypass	60.000
23	6+180	6+480	4+395	4+700	Udhampur Bypass	50.000
24	6+480	13+600	4+700	11+500	Udhampur Bypass	60.000
25	13+600	14+000	11+500	11+900	Udhampur Bypass	25 & 32 + 25
26	14+000	18+700	11+900	16+452	Udhampur Bypass	60.000

3.2.4. The salient Feature of Project Road are discussed in the below Table 3.4

Table 3.4 Salient Features

1.	Name of the Project:	Rehabilitation, Strengthening and four laning of Jammu to Udhampur section from km 15.000 (Jammu bypass) to km 67.000 of NH 1A in the state of Jammu & Kashmir
2.	Package No.	NHDP-Phase-II/BOT/VI/J&K
3.	Length (km)	64.58
4.	Date of signing of Concession Agreement with NHAI	19 th July 2010
5.	Appointed Date	17 th June 2011
6.	Name of Concessionaire	M/s SP Jammu Udhampur Highway Pvt. Ltd.
7.	Concession period	20 years
8	Width of Paved Main Carriageway (4lanes)	17.50m (Bypass) and 16.50m (Main Road)
9	Width of Service Road	7.0m (at Jammu bypass) & 5.5m (Rest of section)
10	Main carriageway width	8.25m & 8.75m (including 1.0m & 1.5m width of paved shoulder)
11	Unpaved shoulder	1.0m
12	Bridge width	10.25m (including footpath)
13	Median width	1.5m to 4.5m
14	Cross slopes	2.5% on carriageway & 3.0% on soft shoulder.
15	Embankment slope	1V:2H
16	Super elevation	7.0% (maximum)
17	Pattern of widening	
	a) One side widening	14.77 km
	b) Two side widening	25.96 km
	c) Realignment	23.849 km
	d) By passes	15.2000 km to 20.300 km (Jammu by pass)
	e) Service Road	10.200 km to 22.400 km (Nagrota Bypass) 0.00 km to 16.452 km (Udhampur Bypass) 17.362 km
18	Design Speed	45 km/hr.(Min.) &85 km/hr. (Max)
19	Major Bridges	21 Nos
20	Minor Bridges	22 Nos
21	Viaduct	22 Nos. (Major-15 and Minor-7)

22.	Culvert	212 Nos.
23	Bus lay byes	28 Nos.
24	Truck lay byes	13 Nos.
25	Underpass	12 (3 Pedestrian and 9 Vehicular)
26	Major Intersections	14 Nos.
27	Minor Intersections	07 Nos.
28	Tunnels	4 twin tubes
29	Toll Plaza	1 No. at km 22.600 in village Ban at end of Nagrota bypass.

ACCIDENT DATA COLLECTION AND ANALYSIS

4.1. Study Area

The Project road "Jammu Bypass to Udhampur” is a section of NH-1A starting at km 15+200 on Jammu Bypass and terminating at the North end of Udhampur Bypass km 67.000 of NH-1A. The total length of Project Highway is 64.579 Km. On its way, it bypasses the major township of Nagrota and Udhampur with developing commercial activities. Project road follows the alignment of NH-1A from Km 9.350 to Km 9.900; thereafter it follows new alignment for proposed bypass of Nagrota again to meet NH – 1A at Km 21.780 of main road. From this point onward, the project road follows the alignment of NH1A up to Km 50.330 Km. Thereafter it again follows new alignment for proposed Udhampur Bypass to meet again at existing Km 67.00 of NH-1A. 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 well-known tourist spots of the state. The road consists of mixed traffic.

The Accidents data are collected from FIR (First Information report) which are recorded under the IPC Codes 304a, 338,337 &279 in different police stations and are also collected from concessionaire at the end of every month. The accident data collected from February 2016 to November 2016 except the month of June. The collected accident data is of 9 months. This accident data contains location of accident and details of severity of accidents i.e. fatal injury, minor injury and property damage etc. These are the police stations come under aforesaid road sections:

Table 4.1 List of Police stations

S.NO	Police Stations
1	Police Station Udhampur
2	Police Station Rehmbal
3	Police Post Tikri
4	Police Station Jhajjar Kotli
5	Police Post Nagrota
6	Police Post Sidhra
7	Police Control Room Jammu

4.2. Analysis of accident data

After collecting accident data of 2016, a complete analysis can be done for all the accidents which occurs at various locations, in order to know the cause of accidents, nature of accidents, classification of accidents, Type of collisions, types of vehicle involved in the accident and month wise classification is shown. The analysis has been performed and the results are shown in Figures 4.1to 4.6.

- Nature of Accident

Table 4.2 Percentage Nature of Accident

Nature	No of Accidents	Percentage
Fatal	15	6 %
Serious Injury	156	63%
Minor Injury	77	31%

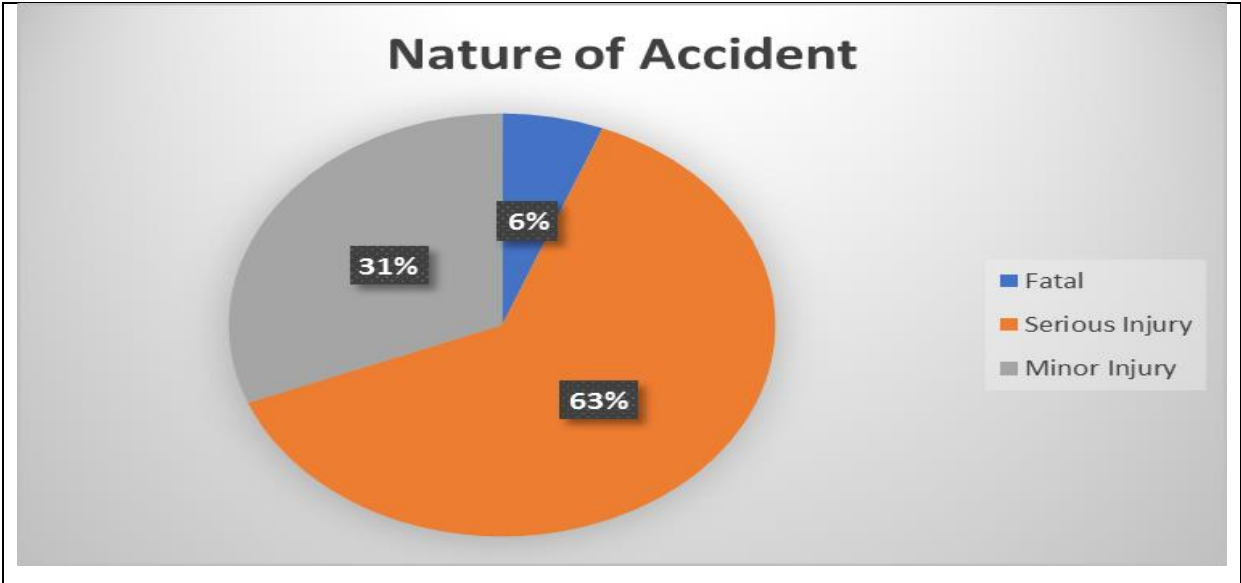


Figure 4.1 Nature of Accident

As per Figure 4.1 the nature of accidents is serious injury in 63% cases 31% cases are minor injury. However, the road fatalities are less than 6%. The reason behind the serious injuries being large in number is because the existing highway having hilly mountainous terrain has blind and steep curves. National Highway have high speed standards where it is difficult to control the speed due to improper pedestrian crossing and wrong side vehicle movement and sight distance problems.

- Type of Vehicles involved in the accident

Table 4.3 Percentage Type of Vehicles involved in the Accident.

Type of Vehicles	No of Accidents	Percentage
Tempo	2	2%
Truck	10	9 %
Bus	9	8 %
Car	39	35 %
Auto	2	2 %
Scotty	9	8 %
Motor cycle	37	33 %
Tractor	1	1 %
Unknown vehicle	2	2%

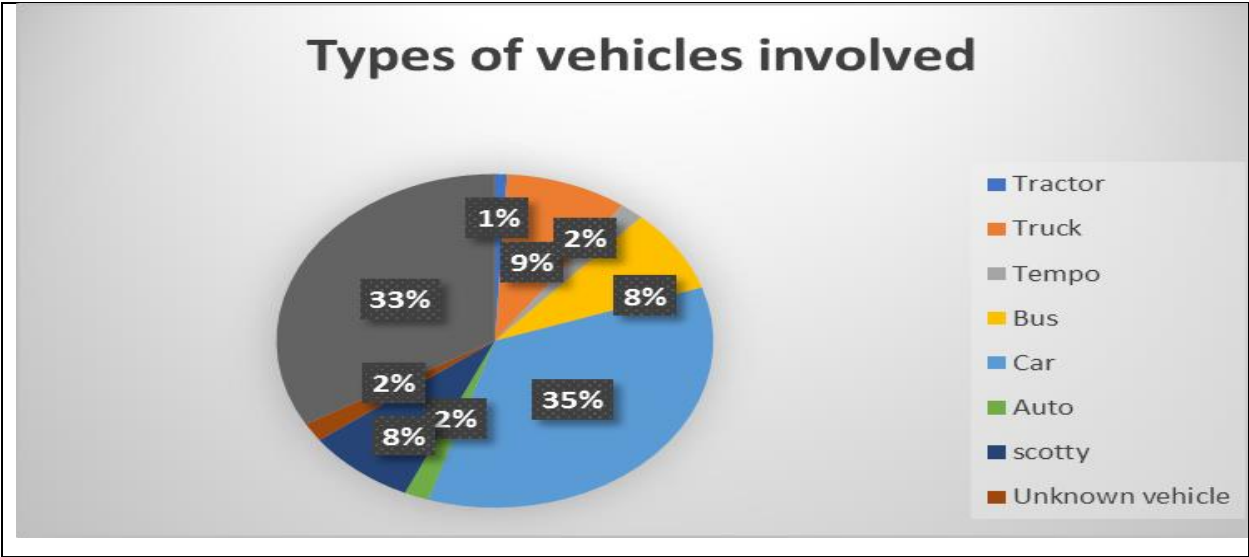


Figure 4.2 Types of vehicles involved in Accidents

Figure 4.2 shows that most of the accident are caused by cars (35%) and motor cycles (33%). The reason behind this lack of adoption of safety measures like seat belts, helmets by road users.

- **Cause of Accident**

Table 4.4. Percentage of cause of accidents

Causes	No of Accidents	Percentage
Vehicle out of control	31	29 %
Overspeeding	52	49 %
Mechanical Defect of motor vehicle	5	5 %
Driver Drunk	8	8 %
Hit and Run+Cardic Arrest	2	2 %
Driver Fault	6	6 %
Data not Available	2	2 %

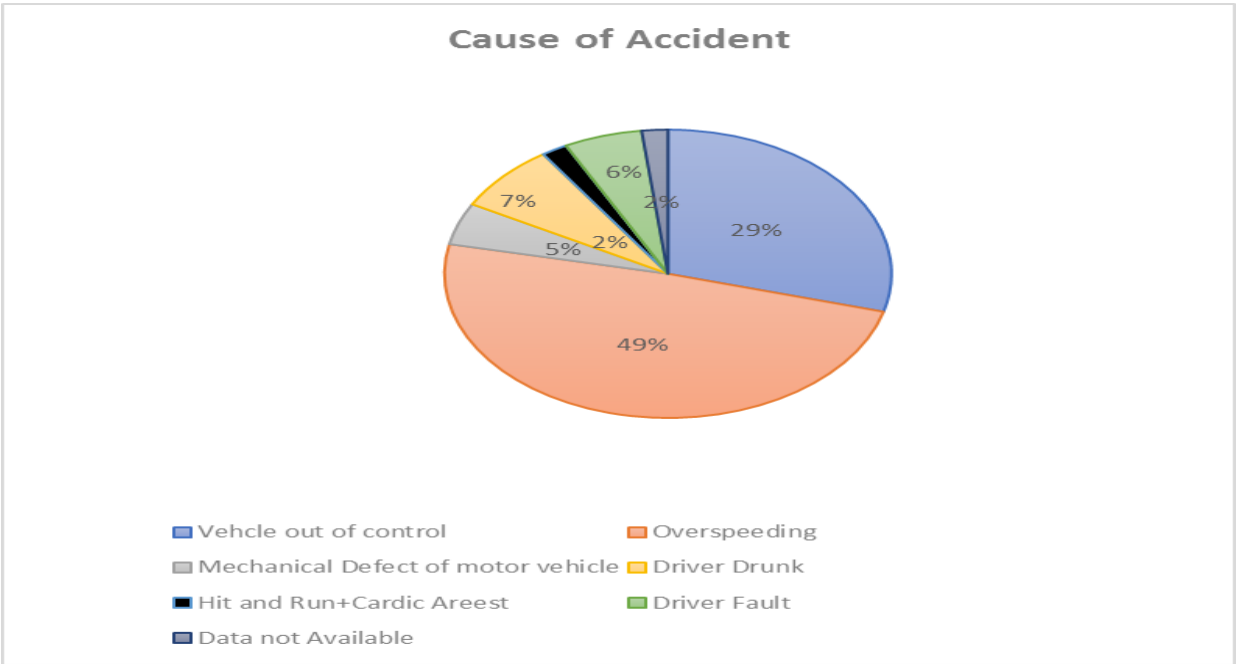


Figure 4.3 Cause of Accidents

Figure 4.3 shows that the major cause of the accidents is over speeding i.e. 49% and vehicle spinning out of control (29 %), because the project highway has hilly mountainous terrain which have blind and sharp curves. This makes it difficult to control speed which causes overturning of vehicles.

- **Type of collision**

Table 4.5 Percentage of Different types of collisions

Type	No of Accidents	Percentage
Skidding	49	40 %
Right turn Collision	2	2 %
Overturning	37	30 %
Hit and Run	3	2 %
Rear End Collision	7	6 %
Cardiac Arrest	2	2 %
Head on Collision	21	17 %
Data Not Available	2	2 %

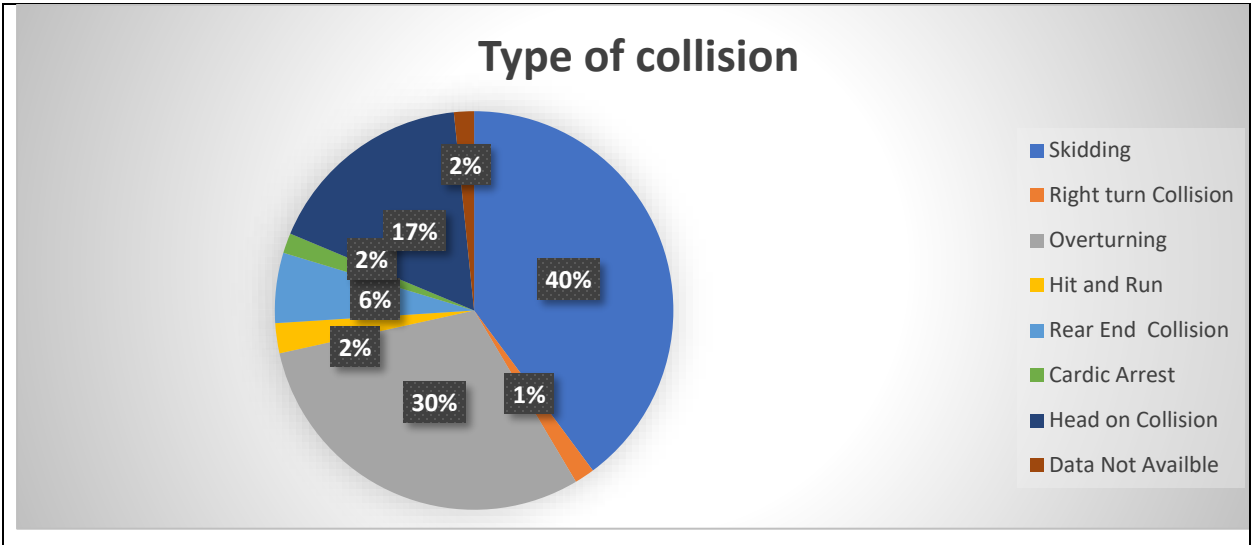


Figure 4.4Type of collision

Figure 4.4 shows that the Maximum collision occurs due to skidding of vehicle which accounts for 40 % of the total collisions. The reason behind that it is the hilly mountainous terrain of the project highway causing high-speed consequently skidding of vehicle. The second type of collision are also large in number having high percentage is overturning i.e.30 %. blind and sharp curves and high speed having tendency to overturn the vehicles. Head on Collision also having high number at 17%. The Main cause of Head on Collisions is wrong side movement.

- **Number of accidents according hourly**

Table 4.6No of Accidents in different hours

Time(hours)	No of Accidents
0.00-1.00	1
1.00-2.00	1
2.00-3.00	1
3.00-4.00	1
4.00-5.00	1
5.00-6.00	1
6.00-7.00	3
7.00-8.00	5
8.00-9.00	1
9.00-10.00	4
10.00-11.00	6
11.00-12.00	7
12.00-13.00	8
13.00-14.00	3
14.00-15.00	6
15.00-16.00	11
16.00-17.00	4
17.00-18.00	8
18.00-19.00	7
19.00-20.00	7
20.00-21.00	2
21.00-22.00	9
22.00-23.00	1
23.00-24.00	1

Maximum no of accidents during day hours (6.00 AM to 6.00 PM) occurs during the period of 15.00-16.00 PM and Maximum no of accidents occur during night hours (6.00 PM to 6.00 A M) during the period of 21.00-22.00 PM.

- **Month wise distribution of number of accidents**

Table 4.7 Month wise Distribution of number of accidents.

Month	No of accidents
February	6
March	9
April	9

May	14
July	11
August	15
September	17
October	12
November	14

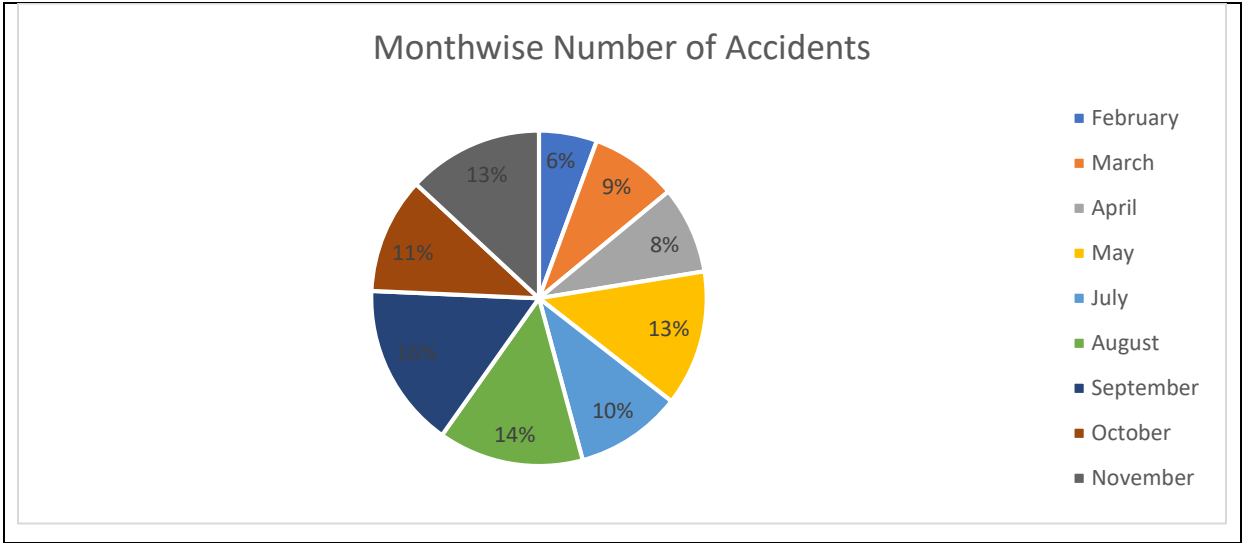


Figure 4.5Month wise Number of Accidents

Figure 4.5 shows that the maximum number of accidents occur during the month of September i.e.17. and minimum number of accidents occur during the month of February i.e.9.

• **Month wise distribution of accidents fatalities**

Table 4.8 Month wise Distribution of Accidents Fatalities

Month	Fatal	Serious injury	Minor injury
February	-	19	3
March	1	21	10
April	1	19	10
May	-	17	11
July	2	23	14
August	2	16	16
September	3	17	10
October	4	12	10
November	2	14	4

4.3 Calculation of Accident Severity Index (ASI)

For estimation of ASI, the fatal accidents are assigned a weightage 10, A serious injury is assigned a weightage 7 and 4 is assigned to minor injury accident.

Based on Fatal, Serious & Minor Accidents.

ASI = (N_f \times W_f) + (N_s \times W_s) + (N_m \times W_m)(4.1)

Where, N_f= No of fatal accidents at the location

W_f= Weight age assigned to fatal accident

N_s = No of serious accidents at the location

W_s= Weight age assigned serious accident

N_m = No of minor accidents at the location

W_m= Weight age assigned to minor accident

Table 4.10 gives details calculations of ASI at different Locations.

Table 4.9 Calculations of Average Severity Index(ASI)

Chainage	Location	No of fatal injuries, N_f	(N_f \times W_f)	No of serious injuries, N_s	(N_s \times W_s)	No of minor injuries, N_m	(N_m \times W_m)	ASI = (N_f \times W_f) + (N_s \times W_s) + (N_m \times W_m)
B24	MR RHS	2	20	0	0	0	0	20
23+050	MR LHS	0	0	2	14	0	0	14
31+080	MR LHS	0	0	4	28	4	16	44
24+190	MR RHS	0	0	2	14	0	0	14
V3	MR RHS	0	0	1	7	1	4	11
20+800	RHS NBP	0	0	3	21	2	8	29
0+450	UBP RHS	0	0	1	7	0	0	7
21+900	MR	0	0	2	14	0	0	14
18+620	NBP	0	0	1	7	3	12	19
07+090	UBP LHS	0	0	5	35	0	0	35
36+468	MR LHS	0	0	0	0	4	16	16
28+000	RHS MR	0	0	1	7	0	0	7
30+450	LHS MR	0	0	1	7	1	4	11
21+500	RHS MR	0	0	1	7	0	0	7
18+500	RHS JBP	0	0	1	7	1	4	11
20+290	RHS NBP	0	0	1	7	0	0	7

10+500	RHS NBP	0	0	1	7	0	0	7
18+760	LHS NBP	1	10	2	14	2	8	32
21+800	RHS MR	0	0	1	7	0	0	7
Nagrota Old Road		1	10	1	7	0	0	17
15+560	RHS NBP	0	0	1	7	0	0	7
17+500	LHS NBP	0	0	1	7	1	4	11
22+700	RHS MR	0	0	1	7	0	0	7
46+730	RHS MR	0	0	1	7	0	0	7
30+300	LHS MR	0	0	1	7	0	0	7
T4 LHS	MR	0	0	1	7	2	8	15
43+100	MR RHS	0	0	1	7	0	0	7
B23	RHS	0	0	1	7	0	0	7
B23	RHS	0	0	1	7	0	0	7
20+300	NBP LHS	0	0	1	7	0	0	7
9+960	NBP LHS	0	0	1	7	1	4	11
12+270	NBP LHS	0	0	2	14	0	0	14
48+650	MR RHS	0	0	2	14	1	4	18
B23	RHS	0	0	1	7	0	0	7
15+570	NBP RHS	1	10	0	0	1	4	14
18+720	JBP RHS	0	0	1	7	0	0	7
31+260	MR RHS	0	0	1	7	0	0	7
29+890	MR RHS	0	0	1	7	0	0	7
26+200	MR RHS	0	0	1	7	0	0	7
T1	MR LHS	1	10	0	0	0	0	10
29+200	RHS MR	0	0	4	28	4	16	44
46+000	LHS MR	0	0	1	7	1	4	11
48+800	RHS MR	0	0	1	7	0	0	7
13+840	RHS NBP	0	0	1	7	0	0	7
19+460	RHS NBP	1	10	0	0	0	0	10
18+400	LHS NBP	0	0	1	7	0	0	7
17+500	LHS NBP	0	0	1	7	0	0	7
18+650	RHS NBP	0	0	1	7	1	4	11
10+230	RHS NBP	0	0	1	7	0	0	7
12+770	RHS NBP	1	10	1	7	0	0	17
18+480	LHS NBP	0	0	1	7	1	4	11
22+640	RHS MR	0	0	1	7	0	0	7
18+650	LHS NBP	0	0	1	7	0	0	7
T1	RHS MR	0	0	1	7	1	4	11

T4	MR	0	0	1	7	0	0	7
32+040	RHS	0	0	0	0	2	8	8
12+710	RHS NBP	1	10	0	0	0	0	10
22+800	LHS	0	0	1	7	0	0	7
14+500	LHS NBP	0	0	1	7	1	4	11
20+300	LHS JBP	0	0	0	0	2	8	8
32+540	LHS MR	0	0	1	7	0	0	7
29+100	LHS MR	0	0	1	7	1	4	11
B21	RHS	0	0	1	7	1	4	11
V3	RHS MR	0	0	2	14	0	0	14
Toll Plaza	-	0	0	2	14	2	8	22
Old Nagrota National Highway		3	30	1	7	0	0	37
111+870	RHS NBP	1	10	0	0	1	4	14
15+300	LHS NBP	0	0	1	7	1	4	11
B22	LHS	0	0	1	7	1	4	11
19+450	LHS NBP	0	0	3	21	2	8	29
26+550	RHS MR	0	0	2	14	0	0	14
30+450	LHS MR	0	0	10	70	3	12	82
34+400	LHS MR	0	0	0	0	1	4	4
11+160	RHS NBP	0	0	1	7	0	0	7
15+080	LHS NBP	0	0	1	7	1	4	11
19+070	RHS NBP	1	10	2	14	3	12	36
18+500	LHS JBP	0	0	1	7	0	0	7
22+640	Toll Plaza	0	0	1	7	0	0	7
28+400	RHS MR	0	0	7	49	0	0	49
22+640	LHS NBP	0	0	3	21	0	0	21
29+100	LHS NBP	0	0	4	28	0	0	28
26+500	RHS NBP	0	0	1	7	1	4	11
48+870	LHS MR	0	0	0	0	2	8	8
B-24	RHS MR	0	0	4	28	0	0	28
15+560	RHS NBP	0	0	2	14	1	4	18
13+480	RHS NBP	0	0	1	7	2	8	15
18+300	RHS NBP	0	0	1	7	1	4	11
17+860	RHS NBP	0	0	2	14	0	0	14
19+220	LHS NBP	0	0	1	7	1	4	11
18+920	RHS NBP	0	0	1	7	1	4	11
17+560	LHS NBP	0	0	1	7	0	0	7
18+720	RHS NBP	0	0	1	7	0	0	7

48+300	LHS MR	0	0	1	7	1	4	11
29+800	RHS MR	0	0	2	14	1	4	18
20+640	LHS MR	0	0	1	7	0	0	7
17+080	RHS MR	0	0	1	7	2	8	15
13+200	LHS NBP	0	0	1	7	0	0	7
23+400	LHS MR	0	0	1	7	1	4	11
35+050	Main Road	0	0	1	7	0	0	7
47+020	MR LHS	0	0	4	28	2	8	36
18+700	NBP	1	10	0	0	2	8	18
22+640	LHS	0	0	2	14	0	0	14
26+310	RHS	0	0	4	28	4	16	44
B-24		0	0	2	14	1	4	18
23+800	MR LHS	0	0	2	14	0	0	14
13+020	RHS NBP	0	0	2	14	0	0	14
B-23	Median	0	0	2	14	0	0	14

4.4. Calculations of Black Spots

Black spots are the locations on roads which have high accident potentials and generally have large number of crashes on that locations.

Locations having Accident severity index (ASI) having value higher than threshold value are classified called as hazardous spots or black spots.

Threshold value can be calculated as = Average severity + 1.2 (Standard deviation)

From Table 4.10,

Average Severity = 14.485

Standard Deviation = 11.559

Threshold value = 28.357

There are 14 Spots having ASI more than threshold value which are treated as Black Spots.

Table -4.10 shows spots and location which treated as black spots and their ASI values

Spot / Chainage	Location	ASI
31+080	MR LHS	44
20+800	RHS NBP	29
07+090	UBP LHS	35
18+760	LHS NBP	32
29+200	RHS MR	44
Old Nagrota National Highway	-	37

19+450	LHS NBP	29
30+450	LHS MR	82
19+070	RHS NBP	36
28+400	RHS MR	49
29+100	LHS NBP	28
B-24	RHS MR	28
47+020	MR LHS	36
26+310	RHS	44

4.5 Chainages having Black spots.

Following Figures 4.6 to 4.18 shows black spots at different chainage locations.

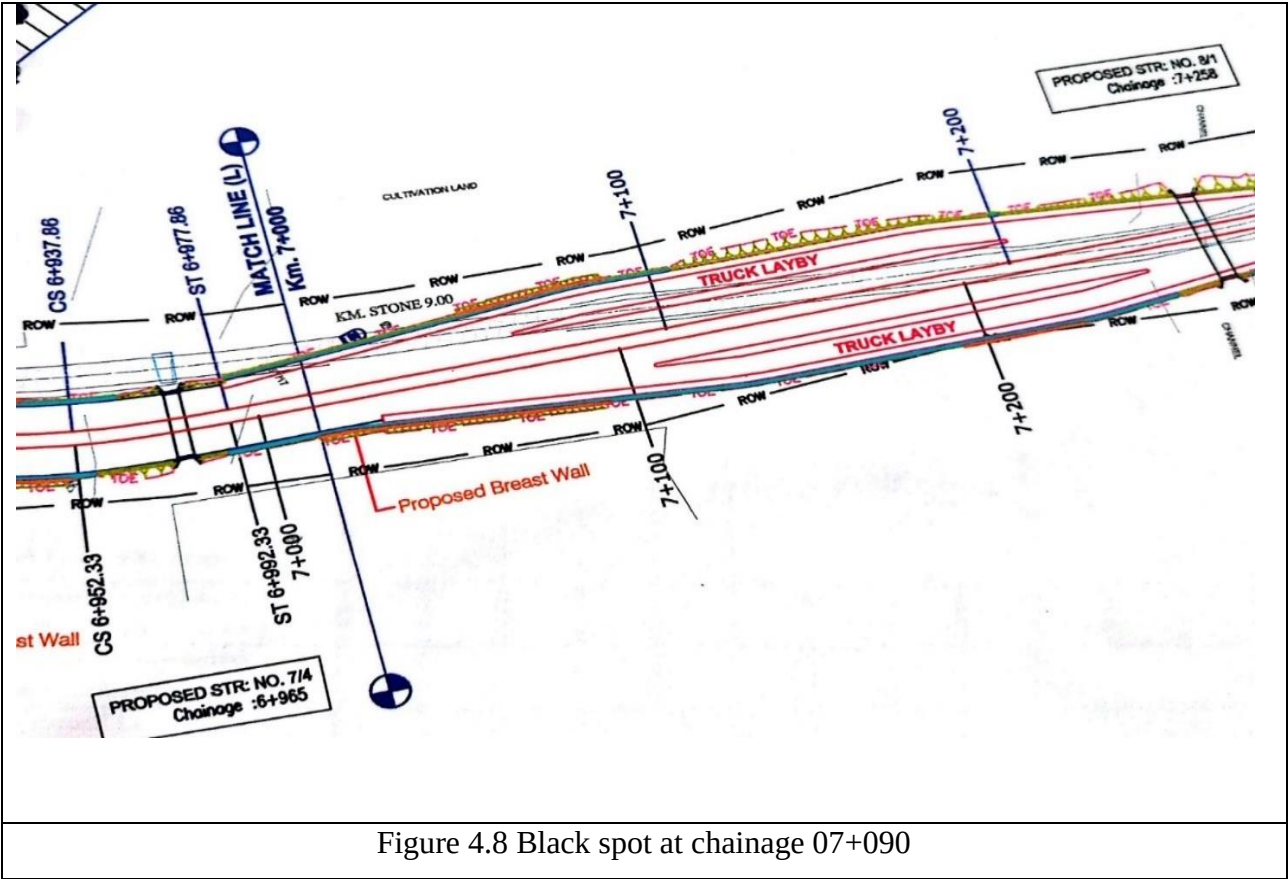


Figure 4.8 Black spot at chainage 07+090

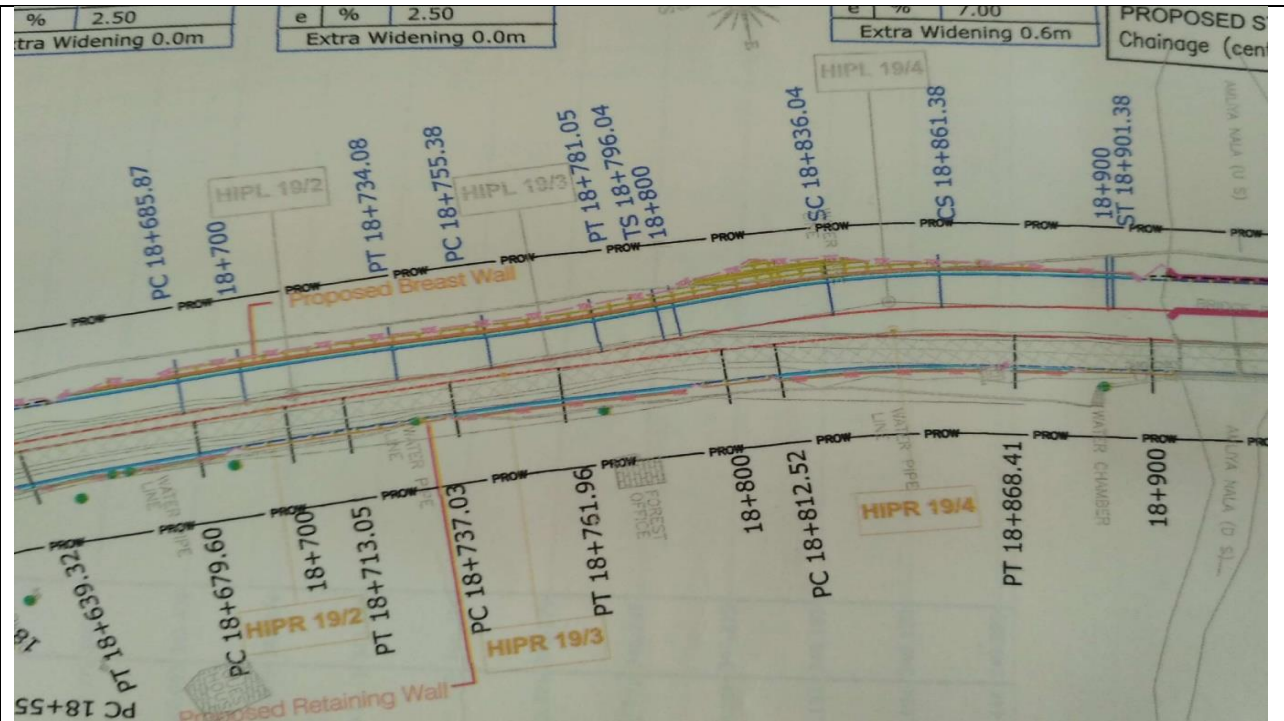


Figure 4.9 Black spot at chainage 18+760

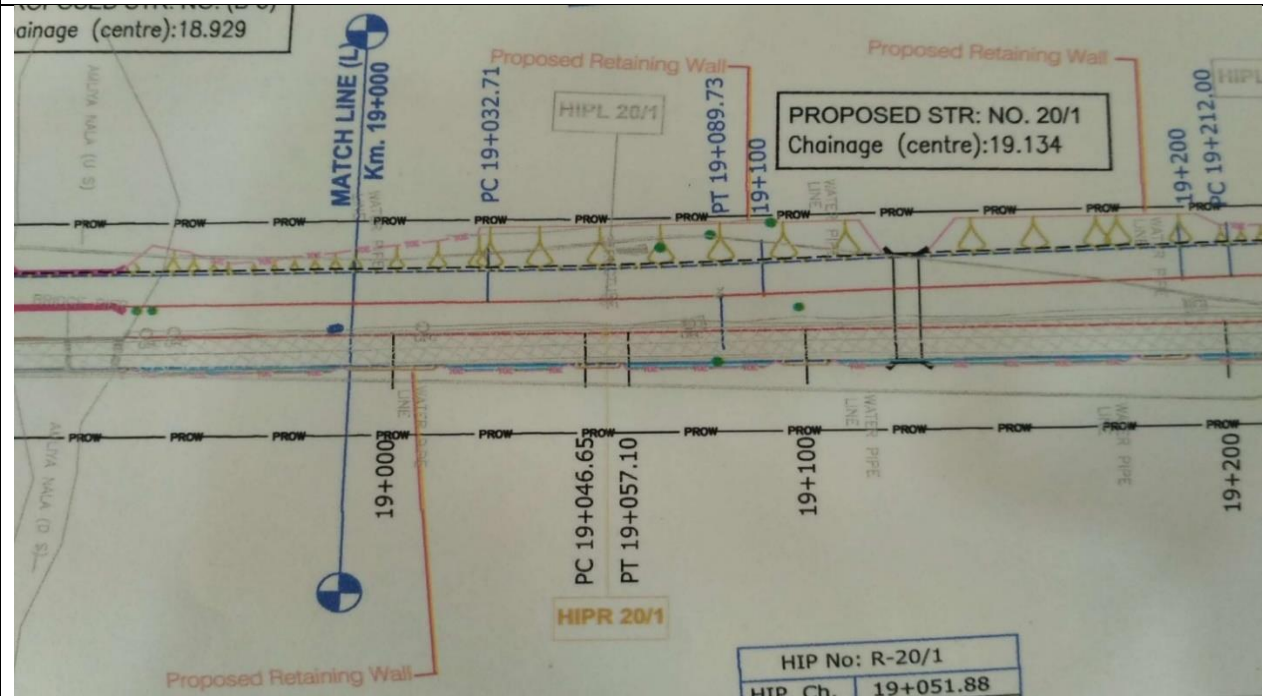
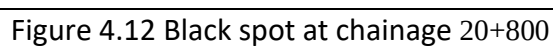
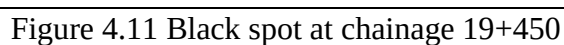


Figure 4.10 Black spot at chainage 19+070



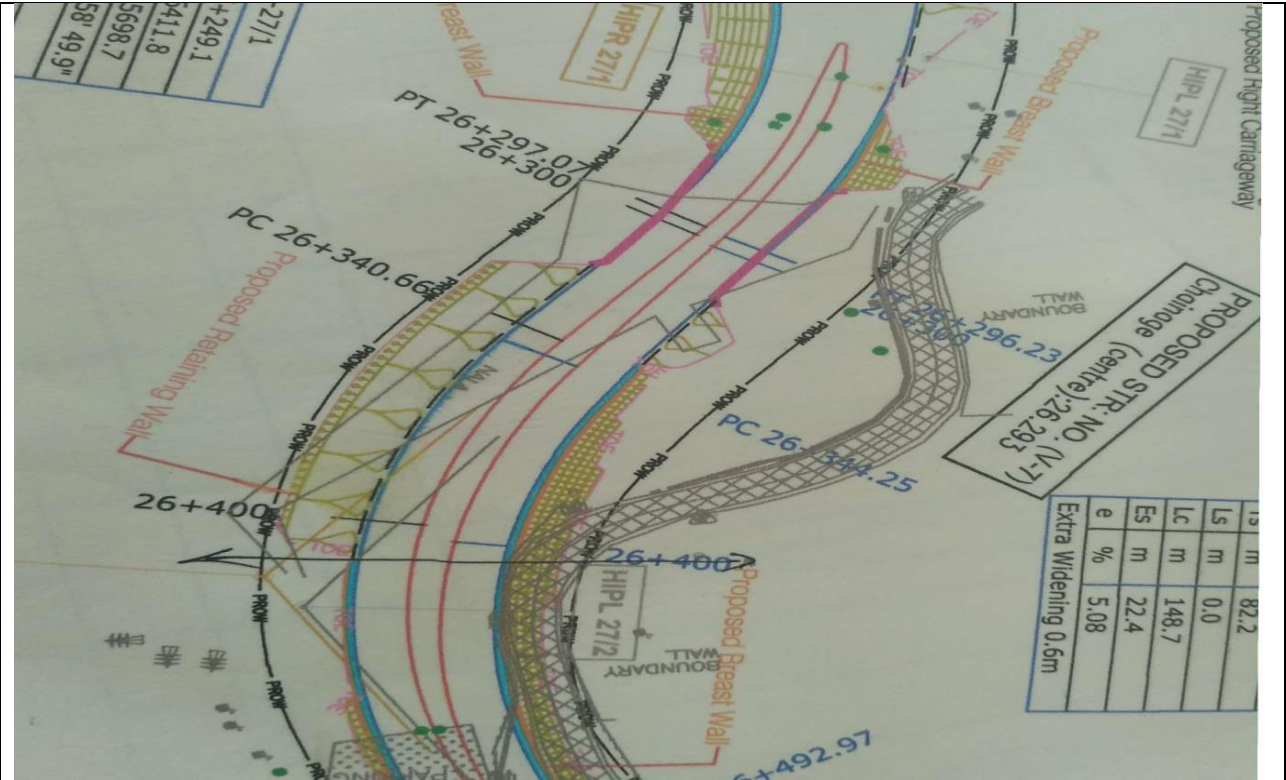


Figure 4.13 Black spot at chainage 26+310

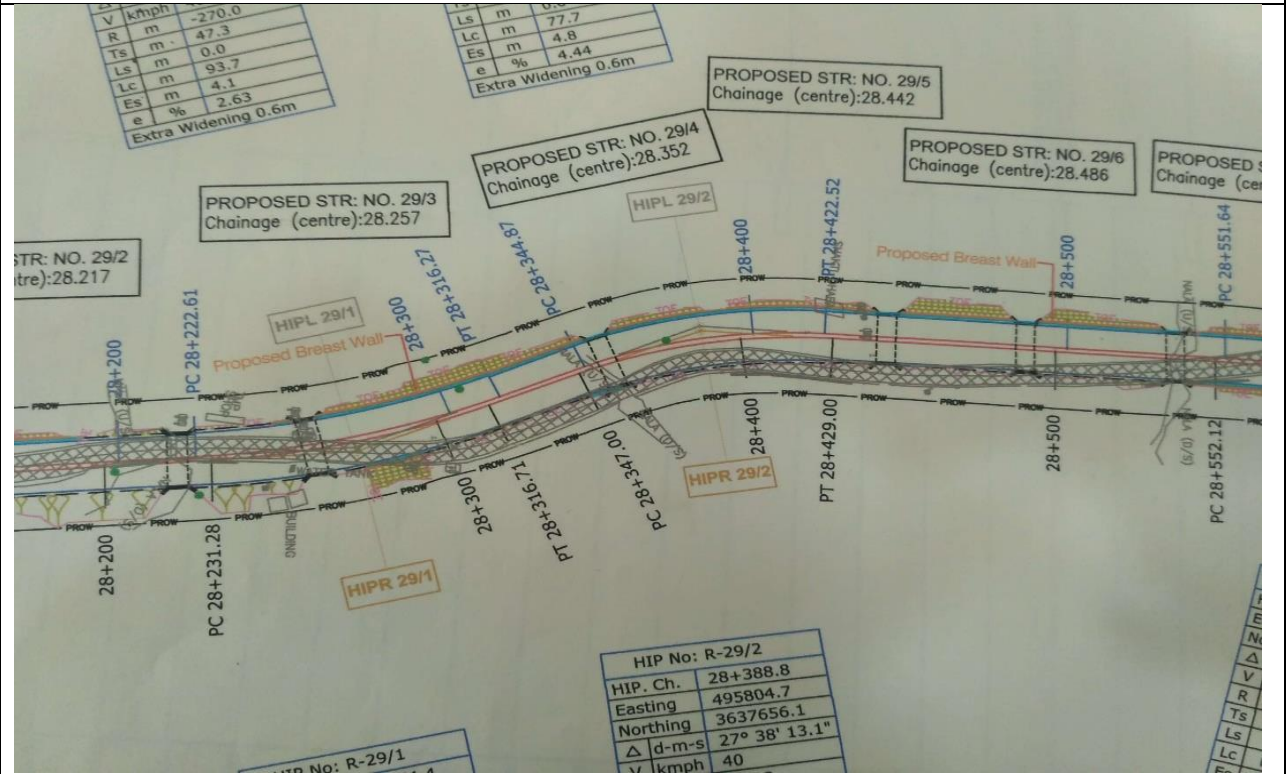


Figure 4.14 Black spot at chainage 28+400

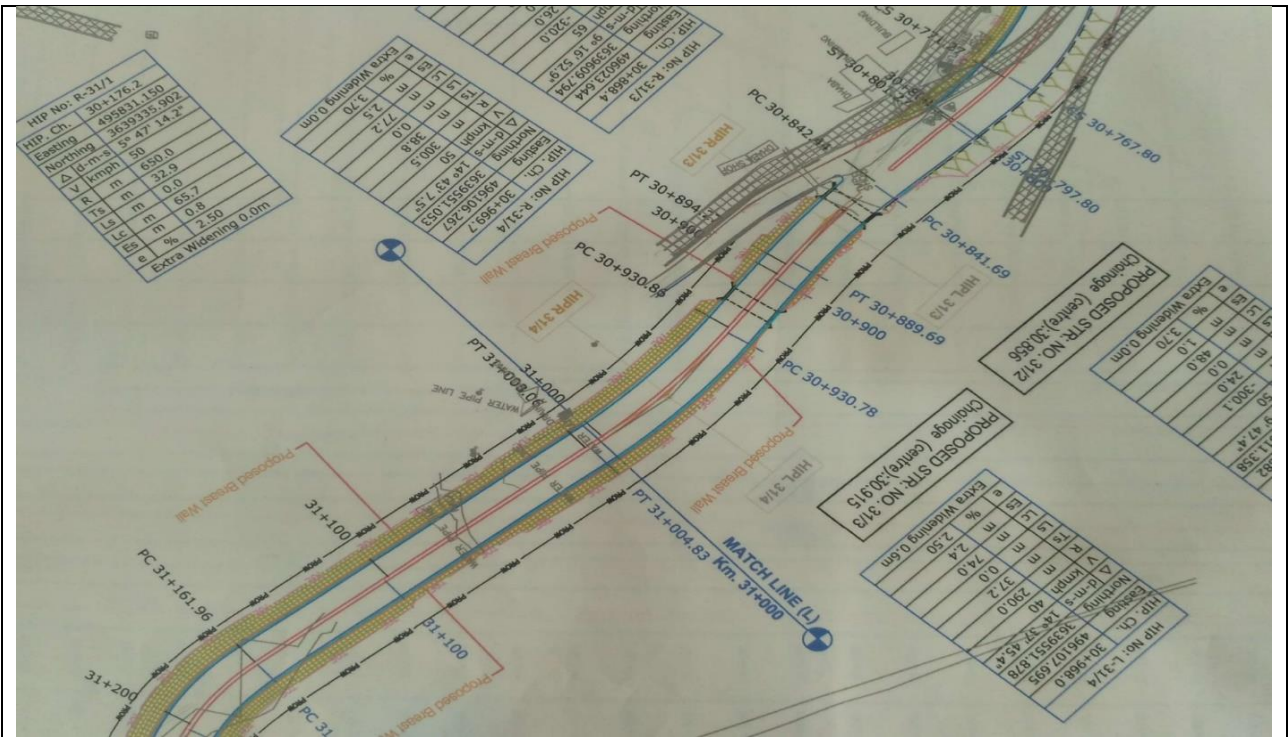


Table 4.12 Rate per million of entering vehicles, (RMEV)

S.N O	Chainage	No of Crashes	Average daily traffic	ADT X 365	$RMEV = \frac{A \times 1000000}{V}$
1	B24	2	18970	6924050	0.28884829
2	23+050	2	18970	6924050	0.28884829
3	31+080	8	18970	6924050	1.155393159
4	24+190	2	18970	6924050	0.28884829
5	V3	6	18970	6924050	0.866544869
6	20+800	5	18970	6924050	0.722120724
7	0+450	1	18970	6924050	0.144424145
8	21+900	2	18970	6924050	0.28884829
9	18+620	4	18970	6924050	0.577696579
10	07+090	5	18970	6924050	0.722120724
11	36+468	4	18970	6924050	0.577696579
12	28+000	1	18970	6924050	0.144424145
13	30+450	2	18970	6924050	0.28884829
14	21+500	1	18970	6924050	0.144424145
15	18+500	2	18970	6924050	0.28884829
16	20+290	1	18970	6924050	0.144424145
17	10+500	1	18970	6924050	0.144424145
18	18+760	5	18970	6924050	0.722120724
19	21+800	1	18970	6924050	0.144424145
20	Nagrota Old Road	2	18970	6924050	0.28884829
21	15+560	1	18970	6924050	0.144424145
22	17+500	2	18970	6924050	0.28884829
23	22+700	1	18970	6924050	0.144424145
24	46+730	1	18970	6924050	0.144424145
25	30+300	1	18970	6924050	0.144424145
26	T4 LHS	3	18970	6924050	0.433272434
27	43+100	1	18970	6924050	0.144424145
28	B23	1	18970	6924050	0.144424145
29	B23	1	18970	6924050	0.144424145
30	20+300	1	18970	6924050	0.144424145
31	9+960	2	18970	6924050	0.28884829
32	12+270	2	18970	6924050	0.28884829
33	48+650	3	18970	6924050	0.433272434
34	B23	1	18970	6924050	0.144424145
35	15+570	2	18970	6924050	0.28884829
36	18+720	1	18970	6924050	0.144424145

37	31+260	1	18970	6924050	0.144424145
38	29+890	1	18970	6924050	0.144424145
39	26+200	1	18970	6924050	0.144424145
40	T1	1	18970	6924050	0.144424145
41	29+200	8	18970	6924050	1.155393159
42	46+000	2	18970	6924050	0.28884829
43	48+800	1	18970	6924050	0.144424145
44	13+840	1	18970	6924050	0.144424145
45	19+460	1	18970	6924050	0.144424145
46	18+400	1	18970	6924050	0.144424145
47	17+500	1	18970	6924050	0.144424145
48	18+650	2	18970	6924050	0.28884829
49	10+230	1	18970	6924050	0.144424145
50	12+770	2	18970	6924050	0.28884829
51	18+480	2	18970	6924050	0.28884829
52	22+640	1	18970	6924050	0.144424145
53	18+650	1	18970	6924050	0.144424145
54	T1	2	18970	6924050	0.28884829
55	T4	1	18970	6924050	0.144424145
56	32+040	2	18970	6924050	0.28884829
57	12+710	1	18970	6924050	0.144424145
58	22+800	1	18970	6924050	0.144424145
59	14+500	2	18970	6924050	0.28884829
60	20+300	2	18970	6924050	0.28884829
61	32+540	1	18970	6924050	0.144424145
62	29+100	2	18970	6924050	0.28884829
63	B21	2	18970	6924050	0.28884829
64	V3	2	18970	6924050	0.28884829
65	Toll Plaza	4	18970	6924050	0.577696579
66	Old Nagrota National Highway	4	18970	6924050	0.577696579
67	111+870	2	18970	6924050	0.28884829
68	15+300	2	18970	6924050	0.28884829
69	B22	2	18970	6924050	0.28884829
70	19+450	5	18970	6924050	0.722120724
71	26+550	2	18970	6924050	0.28884829
72	30+450	13	18970	6924050	1.877513883
73	34+400	1	18970	6924050	0.144424145

74	11+160	1	18970	6924050	0.144424145
75	15+080	2	18970	6924050	0.28884829
76	19+070	6	18970	6924050	0.866544869
77	18+500	1	18970	6924050	0.144424145
78	22+640	1	18970	6924050	0.144424145
79	28+400	7	18970	6924050	1.010969014
80	22+640	3	18970	6924050	0.433272434
81	29+100	4	18970	6924050	0.577696579
82	26+500	2	18970	6924050	0.28884829
83	48+870	2	18970	6924050	0.28884829
84	B-24	4	18970	6924050	0.577696579
85	15+560	3	18970	6924050	0.433272434
86	13+480	3	18970	6924050	0.433272434
87	18+300	2	18970	6924050	0.28884829
88	17+860	2	18970	6924050	0.28884829
89	19+220	2	18970	6924050	0.28884829
90	18+920	2	18970	6924050	0.28884829
91	17+560	1	18970	6924050	0.144424145
92	18+720	1	18970	6924050	0.144424145
93	48+300	2	18970	6924050	0.28884829
94	29+800	3	18970	6924050	0.433272434
95	20+640	1	18970	6924050	0.144424145
96	17+080	3	18970	6924050	0.433272434
97	13+200	1	18970	6924050	0.144424145
98	23+400	2	18970	6924050	0.28884829
99	35+050	1	18970	6924050	0.144424145
100	47+020	6	18970	6924050	0.866544869
101	18+700	3	18970	6924050	0.433272434
102	22+640	2	18970	6924050	0.28884829
103	26+310	8	18970	6924050	1.155393159
104	B-24	3	18970	6924050	0.433272434
105	23+800	2	18970	6924050	0.28884829
106	13+020	2	18970	6924050	0.28884829
107	B-23	2	18970	6924050	0.28884829

4.7. Accidental blackspots, ASI values and their reasons.

Table 4.12 Blackspots with their ASI values and their Reasons.

Spot / Chainage	Location	ASI	Reasons
07+090	UBP LHS	35	Due to presence of truck lay bye
18+760	LHS NBP	32	Presence of Sharp curve, Road side parking on curves, Loose soil is present up to half of its width along the left side of projected highway.
19+070	RHS NBP	36	Wrong side movement of vehicles in main carriageway. Over speeding of vehicles.
19+450	LHS NBP	29	Object hazard marking sign board damaged on the upward side of the bridge.
20+800	RHS NBP	29	At this chainage, elevated road impresses tourists and become an important photography spot. some accidents have also occurred over flyover roads due to photography because people do not follow safety precautions. Closed loop Area may cause sight problem. Improper crossing of pedestrian.
26+310	RHS	44	Over speeding, lack of speed limit sign board.
28+400	RHS MR	49	Congestion of traffic due to roadside shops, Sight problem of vehicles standing near shops, improper crossing of pedestrians.
29+100	LHS NBP	28	Y-intersection, Road side parking of vehicle due to hotels, Dhabas.
29+200	RHS MR	44	Y-intersection, Due to animals’ movement on road or Lack of Advance cattle crossing sign boards.
30+450	LHS MR	82	People standing on the side of the roads and using unfairly as bus stop, sight problem due to road side vegetation. Uneven movement of vehicles on junction
31+080	MR LHS	44	High speed and sharp curve cause overturning, median opening is present near curve. People can directly take U-turn, without adopting any safety measures. De-acceleration lane missing
47+020	MR LHS	36	Median opening is present here. People can directly take U-turn, without adopting any safety measures. Most people don’t know the purpose of de-acceleration lane. The step up and down gradient at median opening, and over speeding cause accidents.

Old Nagrota National Highway	-	37	Lack of safety crash barrier on curves, improper road signs and marking.
B-24	RHS MR	28	Absence of advance stop sign and speed breaker which are approaches to main four lane projected highway

ROAD SAFETY REVIEW OF EXISTING FOUR LANE HIGHWAY

5.1 ROAD SAFETY REVIEW

The site visit was conducted on project highway Jammu-Udhampur NH-1A to review the safety concerns including Black spots which are accident-prone areas, and also to identify the parameters which are hazardous to safety. This is so proper measures can be taken in engineering design with respect safety point of view.

The Jammu-Udhampur National Highway NH-1A has been converted from two lanes to four lanes. Consequently, road standards of roads must be improved. But the mind perception of local road side residents of projected highway does not change. They do not have the proper knowledge of rules and regulations of National Highway. The mains problems observed during the review study shows lack of enforcement of traffic law and order. By carrying out detailed survey along the project highway to identify the black spots, major concerns of road safety and accident-prone areas are identified. The observed cause of accidents is listed below:

- People use wrong side of road for vehicular movement on the main carriageway.
- Pedestrians do not used zebra crossing or pedestrian crossing,
- Movement of pedestrians on the road carriageway.
- Unauthorized bus stops of buses or presence of people for waiting of buses along the roadside.
- Unauthorized median opening made by local people.
- Movement of animals on project highway.
- Roadside vehicle parking specially on curves.
- Presence of roadside shops or restaurants which act as hindrances to traffic movement and cause sight distance problem, this happens because vehicles park along the road and Improper pedestrians crossing further complicate this problem.
- Being a National Highway, the speed of vehicle is too high. Which causes overturning of vehicle at curves.
- People use median opening while taking turn to other direction, but they do not used deacceleration lane. Most of the people do not know the mainly purpose of storage lane or deacceleration lane.
- Some median opening which are near to curve are missing deacceleration lane.
- People do not have good education about rules and regulations of road. They cannot understand the road sign board, road sign marking etc.
- Lack of safety measures adopted at construction zone.
- Earthen shoulders have been damaged due to rain water etc.
- Presence of loose soil on paved shoulder at various locations on the project highway.
- Lack of speed control measures on project highway.



- Absence of advance stop sign and speed breaker at the roads which are approaches to main four lane projected highway.
- Unauthorized direct access to four Lane National Highway.
- Presence of accident involved vehicle on projected highway for a long while, which create hindrances.



Figure 5.1 Start of Project Highway (Jammu by pass) at 15+200(JBP)

Figure 5.2 End of Project Highway NH 1-A (UBP)

All this existing deficiency of four lane highway and recommendations for various particulars are shown as following table:

Table 5.1 Site Deficiency photograph and Recommendations

Chainage	Photograph	Recommendations
Road Side vegetation has grown which obstructs the drivers		
30 +450		Trimming of side vegetation is required near Katra junction. Trees shall be trimmed up to height of 6m in rural and 6.5 m in urban areas above the pavement, as per Manual of specifications and standards for four laning Highway. There should no plantation up to 100 m of median opening for clear distance.
14+000		Provide information, training to workers for each task, and the use of equipment with correct handling techniques and equipment. Also follows the guidelines of Road traffic and work zone safety manual by NHAI.
Absence of Hazard marking sign along at start of service road		
Near Toll Plaza		Provision Hazard marking sign board to be provided at the start of service road as per IRC 67-2012 Code provisions
Absence of safety measures at construction zone		

15+200 (UBP)		Proper barricading of construction area is required as well as proper sign boards of work progress ahead. can be provided. As per IRC 67-2012 and following the guidelines of road traffic and work zone safety manual by NHAI.
15+220 (UBP)		Proper barricading of construction area is required as well as proper sign boards of work progress ahead. can be provided, As per IRC 67-2012.
Presence of road side obstruction		
50+440		Provisions of cautionary signs to be provided as per IRC 67-2012 and pavement markings 'stop' as per IRC 35-2015 be provided.
30+450		Provision for bus stop/ bus lay bye sign boards, as per IRC 80. Markings as well as lighting facilities can be provided for the safety and security of passengers as per IRC 67 and pavement markings as per IRC 35. Rumble strips to be provided at the katra junction.
Presence of animals on the highway		

42+300, 18+700 21+000		Advanced cattle crossing signs boards to be provided, as per IRC 67-2012, Enforcement of law to prevent the animal movement on road. In built up areas underpass shall be constructed with vertical clearance of 5m as per manual of standards and specifications of four laning National Highway.
Congestion due to Road side shops		
28+400	 	Ensure enforcement of law regarding safety adopted by road side shop owners. Provide advance truck lay bye information signboard as per IRC 67-2012 be provided and truck lay bye marking as per IRC- 2015 be provided.
Damage of retro reflective on road sign boards		

19+450		Proper regular maintenance and follow the guidelines as per IRC 67-2012 and also provide speed limit sign board at required locations as per IRC 93-1985. All road signs shall be with retro-reflective sheeting of high intensity grade with encapsulated lens fixed over aluminum substrata as per clause 801 of MORTH specification.
Roadside Parking of vehicles		
All existing road		Road side parking prohibition sign board to be provided specially on curves IRC 67-2012, Provide necessary earthen shoulder space for parking as per IRC: SP: 84 Drain to be covered specially on curves to increase the width as per IRC SP 42.
Poor shoulder condition at various locations		
18+760		Provide advance speed limit sign board is provided as per IRC 67. Ensure the enforcement of law for wrong road parking on curves. Shoulders width can be maintained as per Drawing and maintenance of shoulder can be done as per IRC: SP: 84

All existing road		Do Routine maintenance of edges of paved shoulders and earthen shoulders and maintain its width as per. IRC: SP: 84
Marking colour be diminished at various locations		
All existing road		Do Routine maintenance of colour lane marking, and give re-marking on road as per IRC 35 Code provisions. Road markings of hot applied thermoplastic paints with reflectorizing glass beads as per relevant clauses of Section 803 of MORTH specifications be provided.

At medical facility office.		Roadside obstructions such as poles, crash barrier, columns or embankment lying, concrete dismantle waste material on a road can be relocated Object marking signboard be provided as per IRC 67-2015.
Accidents due to wrongside movement on carriageway		
All existing road		Strict Prohibition should be imposed on wrong side movement of vehicle. There should be a Provision of median opening at every 2-km length.
Accident due to uncovered Drain		
All existing road		Drain covers to be provided, especially on curves. as per IRC SP-42 guide lines for Road drainage.
Absence of de-accleration lane		

All existing road		Provision of De acceleration lane at the median opening which are close horizontal curves as per IRC 73 Code provisions
Improper crossing of Pedestrians		
30+450		Advance Speed limit sign board should be provided as per IRC 67-2012. Pedestrian crossing sign board should be provided as per IRC 67-2012. Ensure enforcement of law to prevent use as unsafe bus stop. Rumble strips should be provided control the speed of vehicle.

6.1 General

Development phase audit is the first stage of audit, which shall be carried out after the completion of preliminary design or examination of typical design aspects of the project at the draft stage. This is the last opportunity where significant changes in the alignment of the road can be done in such a way as to avoid any disruption that may occur to the project before the next stage of the road. At this stage detailed design and draft report is prepared which involves various typical considerations about the proposed road such as horizontal and vertical profile of the project, number of lanes, paved or unpaved shoulder width, the proposed cross sections of the road, intersection layouts or interchanges etc. In this chapter plan and profile of the road section is checked by carrying out detailed calculations of horizontal and vertical curves and then comparing it with the given data.

6.2 Horizontal Curve

The Centre line of a road consists of series of straight lines interconnected by curves that are used to change the alignment, direction, or slope of the road. Those curves that change the alignment or direction are known as **horizontal curves**.

6.2.1 Checking of Data for Horizontal curves.

For this project, the highway divided into different sections. The different sections are Jammu Bypass, Nagrota Bypass, Udampur Bypass and Main road. The horizontal alignment i.e. plan and profile of these sections can be checked according to the IRC: 38-1988 Part 1 i.e. Guidelines for design of horizontal curves.

- Length of curve can be calculated, $L_c = \frac{R \times \pi \times \Delta_c}{180}$ (6.1)

Where:

R is Radius of curve.

Δ_c is deflection angle of the curve/

- Length of Tangent curve $T_s = R \tan \frac{\Delta}{2}$ (6.2)

- Super elevation can be calculated $e = \frac{v^2}{225R}$ (6.3)

Where e = super elevation (%)

v = speed in km/hr.

R = radius of curve in meters

With the help of the equations 6.1 to 6.3, plan and profile for horizontal curves of Jammu-Udampur NH- 1A section has been checked and then compared it with the given values (detailed drawing of NH-1A) of design parameters to determine the difference in length of curve, Tangent Length, and super elevation. Detailed plan and profile for horizontal curves of different sections can be checked in the tables A.1 to A.4 given in ANNEXURE (at the end of report). The following

Table 6.1 shows the locations of chainages having inadequate Super elevation, Length of Tangent curve and inadequate Length of circular curve.

Table 6.1Location of inadequate horizontal curves

Given Value			Super elevation (e %)			Tangent Length(Ts)			Length of curve(Lc)		
Chainage	Location	Side	Design	Cal.	Diff.	Design	Cal.	Diff.	Design	Cal.	Diff.
16+014.1	JBP	LHS	2.5	2.4	0.1	113.3	68.7	44.6	48.19	137.2	-89
22+152.1	JMR	LHS	2.5	2.5	0	149	149	0	15	294	-279
23.995.8	JMR	LHS	7	7	0	44	24	20	8.7	48.70	-40
24+879	JMR	LHS	7	7	0	89	89	0	100.4	140.3	-39
25+937.3	JMR	LHS	5.2	5.2	0	61.5	46.4	15	59.5	89.41	-29.9
30+561	JMR	LHS	7	7	0	1515	1498	17.4	413.3	443.1	-29.8
35+361.7	JMR	LHS	3.2	3.2	0	149	129	20	212.5	253.3	-39.8
39+044	JMR	LHS	6.2	6.2	0	73	52	21	64.8	104.7	-40
40+065	JMR	LHS	2.5	4.39	-1.89	45.7	45.7	0	23	23	0
41+041	JMR	LHS	2.5	6.22	-3.72	61.8	61.8	0	121.9	121.9	0
42+223	JMR	LHS	6.7	6.7	0	59	118	-59	17	235	-117
50+234	JMR	LHS	2.8	2.8	0	104	84	20	122.3	162	-39.7
51+256	JMR	LHS	6.2	6.2	0	94.7	74.6	20	106.3	146.3	-40
23+976	JMR	RHS	7	7	0	60	32	28	9.7	64.3	-55
24+307	JMR	RHS	7	7	0	71	43	28	25.6	80	-55.2
24+857	JMR	RHS	7	7	0	129	111	18	139.7	174.6	-34.8
30+567	JMR	RHS	7	7	0	1501	1485	17	409	438	-29
35+938	JMR	RHS	7	7	0	78.9	58.7	20.5	72.6	112.9	-39.9
39+030	UMR	RHS	6.3	6.3	0	73.9	53.9	20	66.8	106.6	- 40
41+023	UMR	RHS	2.5	6.25	-3.75	61.5	61.5	0	121	121	0
50+223	UMR	RHS	2.9	2.9	0	104	83.6	20	121	161.1	-40
51+242	UMR	RHS	6.3	6.3	0	94.2	74.2	20	105.7	145.5	-40
1+063	UBP	LHS	7	7	0	110	90	20	132	172	-40
1+063	UBP	RHS	7	3.3	3.7	135	91	43	111.4	175	-63
1+434	UBP	RHS	4.7	4.7	0	91.6	79	12	131.1	156	-25
1+435	UBP	LHS	4.7	7	-2.3	91.7	80	12	131.4	158	-26
10+6639	UBP	LHS	5.3	5.3	0	133	113	20	178.3	218	-40
10+650	UBP	RHS	5.4	6.20	-0.8	131	111	20	175.4	215	-40
10+960	UBP	LHS	6.2	6.1	0.1	100	80	20	116.4	156	-40
10+979	UBP	RHS	6.1	4.69	1.59	101	81	20	118	159	-40
12+085	UBP	RHS	6.5	7	-0.5	97.5	82	15	130	160	-30
12+.018	UBP	LHS	6.2	6.59	-0.3	108	88	20	130.9	171	-40
12+331	UBP	RHS	7	7	0	92	72	20	86	126	-40

12+997	UBP	LHS	6.2	6.06	0.2	88	68	20	94	134	-40
13+059	UBP	RHS	6	6.24	-0.2	89	69	20	96	136	-40
12+331	UBP	RHS	7	7	0	92	72	20	86	126	-40
12+997	UBP	LHS	6.2	6.06	0.2	88	68	20	94	134	-40
13+059	UBP	RHS	6	6.24	-0.2	89	69	20	96	136	-40
12+331	UBP	RHS	7	7	0	92	72	20	86	126	-40
12+997	UBP	LHS	6.2	6.06	0.2	88	68	20	94	134	-40
13+059	UBP	RHS	6	6.24	-0.2	89	69	20	96	136	-40
13+761	UBP	LHS	7	7.00	0.0	109	89	20	120.5	160	-40
13+814	UBP	RHS	7	7.00	0.0	112	92	20	125.8	166	-40
14+155	UBP	LHS	7	7.00	0.0	84.2	64	20	73.6	114	-40
14+213	UBP	RHS	7	4.17	2.8	86.7	66	20	78.14	118	-40
14+470	UBP	LHS	4.2	4.21	0.0	119	99	20	155.7	196	-40
14+530	UBP	RHS	4.21	7.00	-2.8	118.4	98	20	153.7	194	-40
14+845	UBP	LHS	7	7.00	0.0	159.7	140	20	214.6	254	-40
14+901	UBP	LHS	7	7.00	0.0	157.3	137	20	210.16	250	-40
15+179	UBP	LHS	7.00	7.00	0.0	193	63	59	7	123	-116
15+700	UBP	LHS	7	7.00	0.0	197	173	20	260.1	300	-40
15+704	UBP	RHS	7	3.13	3.9	58.7	176	20	265.7	306	-40
15+940	UBP	LHS	3.13	3.11	0.02	58.9	46	12	67.3	92	-25
15+999	UBP	RHS	3.1	7.00	-3.9	58	46	12	67.53	92	-25

6.3 Vertical curves

When there is a change of grade in the vertical alignment of the road it is necessary to introduce a curve known as vertical curve at the intersections of two different grades to smoothen out the vertical profile of the road section and providing ease off the changes in gradient. Design of vertical curves is usually done as per IRC-SP 23 (Guidelines for design of vertical curves).

The two types of vertical curves are as follows:

- 1. Valley Curves
- 2. Summit Curves

6.3.1 Valley Curves

These curves are also known as sag curves with concavity upwards. There is no problem of restriction to sight distance in valley curves during day light.

- The length of valley curves for head light distance can be calculated as:

$$L = \frac{NS^2}{1.5+0.035S}$$

..... (6.4)

Where L= length of summit curve

N = deviation angle (grade difference)

S= Stopping sight distance

For design speed=65km/hr. (As per drawing).

S=90m (As per table 03 from IRC 23)

- Length of summit curve for stopping sight distance (SSD) can be calculated:

$$L = \frac{NS^2}{4.4}$$

.....(6.5)

Where

L = length of the summit curve

For design speed=65km/hr. (As per drawing).

S=90m (As per table 03 from IRC 23)

6.3.2 Calculation of required length for Summit and Valley curve

The data presented in the table A.5 is taken as per drawing for the design of valley curves and summit curves. The value of gradient in and gradient out is calculated from the drawing by subtracting the RL of 1st station from the corresponding station’s RL. The difference between gradient in and gradient out will give the difference in grade calculated in the column 6 of Table A.5. The curve length given in the column 7 is as per the drawing. if gradient in is greater than gradient out the curve will be considered as summit curve and If gradient out is greater than gradient in the curve will be considered as valley curve. The length required as per IRC for valley curve & summit curve is calculated by using equation 6.4 and 6.5 respectively. The Difference in values of curve length is calculated in column 9. Detailed plan and profile for vertical curves of different sections can be checked in the tables A.5 to A.10 given in ANNEXURE. The following Table 6.2 shows the locations of chainages having inadequate Length of curve.

Table 6.2. Location of inadequate Vertical curves

Curve No	Chainage	Location	Side	Type of curve	Curve Length (Given)	Curve Length (cal.)	Curve Length (Diff.)
1	2.275	UBP	RHS	S	60	82	-22.00
2	11.86	UBP	RHS	V	40	51	-11.00
3	3.592	UBP	LHS	V	32	40	-8
4	4.89	UBP	LHS	S	60	86	-26
5	5.13	UBP	LHS	S	60	67	-7
6	16.2	UBP	LHS	S	60	62	-2

7.	18.91	NBP	LHS	S	60	64	-4.00
8	36.650	UMR	RHS	V	100	138	-38.00
9	20.605	JMR	LHS	S	50	51	-1.00

6.4. Summary

For Horizontal Curves: The calculated values of parameters in horizontal curves are approximately equal to the given values. The given values on which design of horizontal curves has been done on NH-1A Jammu-Udhampur section are the rounded off values of calculated values. The number of inadequate horizontal curves are found be 54.out of which 51 Curves have only inadequate length of curve.

For Vertical Curves: The calculated values of Length of vertical curve (L_{sc}) in most of the curves are almost equal to the given values. Mostly the location of inadequate Vertical curves found in Udhampur Bypass i.e. six out of nine curves. But in case of chainage 36.650 of Udhampur Main road having highest difference between the calculated value (138) and given design value (100).

CONCLUSIONS AND RECOMMENDATIONS

7.1 General

This study was performed to know identify the various causes of accidents and frequency of accident. The motive was also to locate the black spots and study the various aspects which affect Road Safety Audit. The accident data was collected for the nine months of the National Highway 1A (Jammu-Udhampur section) from concessionaire and also from the police stations falling in this particular stretch of the section. There are seven districts police stations which come in this stretch. The data was collected at the end of every month for seven months (from February 2016 to November 2016 except the month of June). For the Road safty audit during development phase of the road, drawing was collected to audit the design of vertical and horizontal curves.

7.2 Conclusions

From the study following conclusion can be drawn

- There are fourteen locations which were identified as the black spots since the value of ASI of these locations is more than average ASI (ASI and black spot calculations in sections 4.3& 4.4 explained in Chapter no. 4). The locations are **Main road** (B-24, RHS 29+100 LHS, 29+200 RHS, 28+400 RHS, 30+450 LHS ,31+080 LHS), **NBP** (19+070RHS,18+760 LHS,19+450LHS ,20+800 RHS, **UBP**07+090LHS, Old Nagrota National Highway
- There are five locations having value of RMEV greater than zero which is 31+080 JMR,24+200 JMR, 30+450 JMR, 28+400 JMR, 26+310 JMR.
- The nature of accidents is mainly serious injury 63 % of all cases, and minor injury 31% of all cases. The road fatalities are low at 6%.
- 49%of the accidents were caused due to over speeding and 29 % accidents were due to vehicle going out of control due to high speed.
- Cars and motor cycle mostly involved in the accident having high percentage of 35%, and 33% of all accidents respectively.
- The major type of accident is collision occurring due to skidding of vehicle in of all cases 40 % which is very high. The second type of collision having high percentage is overturning 30 % of all cases. The contribution of Head on Collision 17% of all cases.
- There are 54 inadequate horizontal curves .out of which 51 Curves have only inadequate length of curve. Those curves are listed as follows:

Jammu Bypass. (16+014 LHS).

Jammu main road (22+152.1 LHS, 23.995.8 LHS, 24+879 LHS ,25+937. LHS ,30+561 LHS ,35+361.7 LHS,39+044 LHS), 40+065 LHS, 41+041 LHS, 42+223 LHS, 50+234 LHS, 51+256 LHS, 23+976 RHS, 24+307 RHS, 24+857 RHS, 30+567 RHS, 35+938 RHS.

Udhampur Main Road (39+030 RHS, 41+023 RHS, 50+223 RHS, 51+242 RHS).

Udhampur Bypass 1+063 LHS,1+063 RHS,1+434 RHS, 1+435 LHS, 10+6639LHS,

10+650RHS,10+960LHS,10+979RHS,12+085RHS,12+.018LHS,12+331RHS,12+997LHS,13+059 RHS,12+331 RHS,12+997LHS,13+059 RHS ,12+331 RHS, 12+997 LHS, 13+059 RHS,13+761 LHS,13+814 RHS,14+155LHS,14+213 RHS,14+470LHS, 14+530 RHS,14+845LHS,14+901LHS,15+179LHS,15+700LHS,15+704RHS,15+940LHS,15+999RHS.

- There six horizontal curves having inadequate super elevation which is **UBP** (15+999 RHS, 14.530 RHS,1.435 LHS), **UMR** (41+0.23 RHS), **JMR** (41+041 LHS,41+065 LHS).
- There is one horizontal curve having inadequate tangent length which is **JMR** (42+223 LHS)
- There are nine vertical curves Whose length is inadequate for safe sight distance for 65 kmph at many locations. The curves are listed as follows.

UBP(2.275RHS,11.86RHS,3.59LHS,4.89LHS,5.13LHS,16.2LHS,18.91LHS,**UMR**36.65 0RHS, 20.605 LHS.

7.3 Reasons for concern

- Visibility is affected, if horizontal curve is provided before/after a summit curve it will give kink effect in Visibility.
- Proper co-ordination of horizontal and vertical curve will ensure safety, improve utility of the highway and contribute to overall aesthetics.
- If the deflection angle is small and inadequate length of horizontal curve is provided the driver feels that the curve length is shorter and the radius of curve is smaller than actual value, causing the driver to reduce speed. If the driver tries to drive his vehicle without decreasing speed, the vehicle will run along a larger radius and may enter other lanes and cause collision.
- Inadequate or inconsistent provision of vertical curve length results in poor geometrics, inadequate sight distance and is unsafe for the design speed of the road

7.4 Recommendations

- Proper speed limit signs boards should be provided at the black spots at chainage 30+450,15+220(UBP),50+440(UMR).18+760(NBP)
- Proper shoulder width, median width should be provided and maintained as per IRC: SP:84. at chainage 18+760,29+200,30+450.
- All unauthorized median opening should be closed at chainage at 31+080,31+200,14+100(UBP).
- Adequate horizontal curve length should be provided as per IRC 73, (clause no.9.1.5) Guide lines curve length should be at least 150m for a deflection angle of 5 degree, and this should be increased by 30m for each one degree decrease in deflection angle.
- Highway patrol unit(s) manned by at least two persons apart from the driver for every unit shall continuously patrol the highway in a stretch not exceeding 50 km and shall remain in contact with the Control Room on a real-time basis as per manual of standards and specifications for four laning National Highways

- The drawings to be submitted shall satisfy the requirements (including scale and the size) specified in IRC: SP: 19 and IRC: SP: 54. And as per the requirements specified to the Independent engineer for his review
- For safe traffic operation, vertical clearance between the crown of the carriageway and lowest part of the overhang of the tree available across the roadway shall conform to the standards laid down in IRC: SP: 21
- The plantation in median shall comprise shrubs whose height should normally not exceed 1-1.5 m and shall be as per IRC SP: 21 at chainage 30+450.
- Pedestrian safety guardrail should be provided to guide the pedestrian to the selected crossing /identified locations in accordance with IRC:103 at old Nagrota road.
- The bus bay shall have length to accommodate the expected no. of buses in the peak time. The length and lay out shall be based on those given in IRC: 80. The bus stop lay out shall provide safe entry and exit of buses from the Project Highway and safe movement of passengers. At chainage 30+450 LHS near Katra junction
- At certain locations along the Project Highway some existing eateries (Dhabas) or other informal rest areas are located at chainage 29+100,29+200, 28+400. Every attempt should be made to shift the business of such establishments to the identified planned rest area locations. otherwise, adequate parking spaces for expected peak hour vehicles shall be provided with proper signs and markings
- Drains are required to be the covered-on curves. The cover of the drain shall be designed for carrying the maximum expected wheel load accordance with IRC: SP: 42 and IRC: SP: 50.
- Acceleration Lane/Declaration lane should be provided for a designed speed differential of 60 kmph with Width 5.5 m and 1 in 15 merging tapers beyond design length.
- In urban / built up areas, pedestrian / cattle crossing facility shall be provided at chainage 42+300,18+700,21+000such that pedestrians do not have to walk more than 500 meters to reach the underpass for crossing the Project Highway.

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ANNEXURE

Table A.1 Data Check for Horizontal Curves from Jammu Bypass to End of Udhampur Main Road
(15.200 to 52.000(LHS)

Given value				Designed value			Calculated value			Difference in values		
Chainage (m)	R (m)	V Km /hr.	Δ (°)	e (%)	Ts (m)	Lc (m)	e (%)	Ts (m)	Lc (m)	e (%)	Ts (m)	Lc (m)
15+240.4	1000	80	0.78	2.5	6.8	13.53	2.8	6.8	13.5	-0.34	0.0	0.0
16+014.1	1200	80	6.6	2.5	113	48.19	2.4	68.7	137.24	0.13	44.6	-89.0
17+379.0	2000	80	0.33	2.5	5.8	11.53	1.4	5.8	11.53	1.08	0.0	0.0
17+750.1	3000	65	1.02	2.5	0.6	1.18	0.6	0.6	1.18	1.87	0.0	0.0
20+126.8	119	50	69	7.0	90	143.8	7.0	82.2	143.77	0.0	7.88	0.03
20+308.7	89.5	45	102	7.0	111	159.1	7.0	111	159.45	0.0	-0.28	-0.35
20+466.9	79.3	20	104	2.5	102	144.4	2.2	102	144.39	0.26	-0.09	0.01
20+587.2	80	45	86.1	7.0	74.7	120.2	7.0	74.7	120.17	0.00	-0.04	0.03
20+694.1	114	50	50.5	7.0	53.7	100.4	7.0	53.7	100.34	0.00	-0.01	0.06
20+843.3	98	50	87.3	7.0	93.6	149.4	7.0	93.6	149.31	0.0	0.05	0.09
21+034.9	70.8	40	49.5	7.0	32.6	61.1	7.0	32.6	61.10	0.0	-0.01	0.00
21+099	125	50	25.7	7.0	28.5	56	7.0	28.5	55.98	0.00	0.02	0.02
21+664.7	150	40	40.0	4.7	54.6	104.7	4.7	54.6	104.67	0.00	0.00	0.03
21+863.1	119	40	49.1	6.0	54.2	101.7	6.0	54.2	101.69	0.00	-0.05	0.01
22+412.2	113	50	25.7	7.0	1188	332.2	7.0	25.6	50.38	0.00	1126 2.50	281.8
22+152.1	722	40	23.4	2.5	149	15.3	0.9	149	294.22	1.51	0.04	-278.9
22+487.9	239	50	39.8	4.7	86.2	165.5	4.6	86.3	165.43	0.00	-0.05	0.07
22+679.6	500	65	3.94	3.7	17.2	34.4	3.7	17.2	34.41	0.00	-0.02	-0.01
22+742.4	800	65	4.98	2.5	34.8	69.6	2.3	34.8	69.61	0.15	-0.04	-0.01

22+863.5	157	65	35.1	7.0	49.5	95.8	7.0	49.5	95.79	0.00	0.03	0.01
23+112.5	1000	65	0.87	2.5	7.5	15.1	1.8	7.54	15.08	0.62	-0.04	0.02
23+679.9	240	65	8.62	7.0	18.1	36.1	7.0	18.1	36.08	0.00	0.02	0.02
23+995.8	150	50	18.6	7.0	44.6	8.7	7.0	24.6	48.70	0.00	20.0	-40.00
24+879.2	90	50	89.3	7.0	110	100.4	7.0	89.0	140.30	0.00	20.7	-39.90
25+937.3	135	40	37.9	5.2	61.5	59.5	5.2	46.4	89.41	0.00	15.0	-29.91
30+561	151	50	169	7.0	1515	413.3	7.0	1498	443.12	0.00	17.4	-29.82
30+865.7	300	50	9.16	3.7	24	48	3.7	24.0	47.97	0.00	-0.05	0.03

30+968	290	40	14.6	2.5	37.2	74	2.4	37.2	74.01	0.05	-0.03	-0.01
34+944.1	500	50	11.5	3.7	50.4	100	2.2	50.4	100.50	1.54	-0.05	-0.50
35+063	550	65	7.79	3.4	37.5	74.8	3.4	37.4	74.77	0.00	0.04	0.03
35+361.7	500	60	28.9	3.2	149	212.5	3.2	129	252.33	0.00	20.0	-39.83
35+886.8	300	65	65.9	6.2	195	345.8	6.3	19	345.66	0.00	-0.02	0.00
36+489.8	760	65	1.9	2.5	12.7	25.4	2.47	12.6	25.36	0.03	0.01	0.00
36+579	800	65	4.8	2.5	33.5	67	2.35	33.5	66.98	0.15	-0.03	0.00
36+726	160	65	36.5	7	52.8	102.1	7.00	52.8	102.01	0.00	-0.03	0.00
36+930.6	155	65	64.8	7	98.3	175.2	7.00	98.2	175.11	0.00	0.01	0.00
37+185	265	65	49.3	7	122	227.9	7.00	121.	227.78	0.00	-0.03	0.00
37+384.6	200	65	23.9	7	42.3	83.4	7.00	42.3	83.38	0.00	-0.03	0.00
37+524.4	200	65	24.5	7	43.4	85.4	7.00	43.3	85.34	0.00	0.05	0.00
37+869.4	150	65	43.0	7	59	112.5	7.00	59.0	112.40	0.00	-0.02	0.00
38+272.3	56	65	1.8	2.5	23.9	47.7	7.00	0.89	47.7	-4.5	23.0	0.00
38+378.8	200	65	31.1	7	55.7	108.6	7.00	55.6	108.52	0.00	0.04	0.00
38+534.3	305	65	18.2	6.1	49	97.1	6.16	48.9	97.05	0.00	0.04	0.00
38+736.8	340	65	44.3	5.5	139	263.1	5.52	139	262.92	0.00	0.00	0.00
39+044	302	65	19.9	6.2	73	64.8	6.22	52.9	104.75	0.00	20.0	- 40
39+320.5	200	65	27.8	7	49.5	97.1	7.00	49.5	97.06	0.00	-0.03	0.00
39+499.5	379	45	29.2	2.5	98.7	193.2	2.38	98.7	193.05	0.12	-0.03	0.00
39+798	280	65	37.4	6.7	115	142.6	6.71	94.6	182.51	0.00	20.1	135.89
39+970.9	395	45	3.5	2.5	12	24.1	2.28	12.0	24.04	0.22	-0.03	0.00

40+065	205	45	12.8	2.5	23	45.7	4.39	22.9	45.72	-1.89	0.03	0.00
40+205.6	250	65	22.0	7	48.5	95.9	7.00	48.5	95.82	-0.51	-0.03	0.00
40+446.6	301	65	27.1	6.2	72.5	142.3	6.24	72.4	142.19	0.00	0.02	0.00
40+652	900	65	10.3	2.5	81.2	161.9	2.09	81.1	161.87	0.41	0.01	0.00
41+041	302	65	23.1	2.5	61.8	121.9	6.22	61.7	121.80	-3.72	0.03	0.00
41+359.8	249	65	27.0	7	59.9	117.5	7.00	59.8	117.43	-0.54	0.04	0.00
41+552.9	250	65	35.7	7	80.5	155.7	7.00	80.4	155.67	-0.51	0.01	0.00
41+868.4	400	65	16.1	4.6	56.6	112.4	4.69	56.5	112.31	0.00	0.04	0.00
42+042	303	65	17.8	6.2	47.3	93.9	6.20	47.3	93.83	0.00	-0.02	0.00
42+223.7	2000	65	6.7	2.5	59	117.8	0.94	118	235.45	1.56	-59	0.00
42+475.3	350	65	16.9	5.3	52.1	103.4	5.37	52.1	103.37	0.00	0.01	0.00
42+633.8	760	65	9.1	2.5	60.3	120.3	2.47	60.3	120.21	0.03	0.04	0.00
42+906.5	760	65	8.0	2.5	53.2	106.2	2.47	53.2	106.11	0.03	0.03	0.00
43+010	500	65	8.6	3.7	37.6	75.1	3.76	37.6	75.07	0.00	-0.02	0.00

43+244	495	65	14.4	3.7	62.7	124.6	3.79	62.7	124.59	0.00	0.04	0.00
43+431.8	505	65	21.7	3.7	96.8	191.3	3.72	96.8	191.21	0.00	-0.02	0.00
43+678.7	396	65	27.3	4.7	96	188.4	4.74	96.0	188.33	0.00	-0.03	0.00
43+957.9	804	65	12.0	2.5	84.8	168.9	2.34	84.7	168.81	0.16	0.04	0.00
44+182.6	301	65	17.4	6.3	46.2	91.6	6.24	46.1	91.58	0.10	0.03	0.00
44+554.8	1000	65	13.0	2.5	114	226.9	1.88	114	226.74	0.62	-0.02	0.00
44+858.6	600	65	17.8	3.1	94.1	186.6	3.13	94.1	186.49	0.00	0.05	0.00
45+039.1	764	65	9.5	2.5	63.3	126.3	2.46	63.3	126.27	0.04	-0.01	0.00
45+416.6	796	65	20.2	2.5	142	280.6	2.36	142	280.49	0.14	0.01	0.00
45+639	504	65	16.0	3.7	71	141.1	3.73	71.0	141.03	0.00	-0.02	0.00
45+825.1	496	65	12.1	3.8	52.5	104.5	3.79	52.5	104.46	0.00	0.05	0.00
45+897	1000	65	1.1	2.5	9.2	18.4	1.88	9.21	18.41	0.62	-0.01	0.00
46+004.6	800	65	4.2	2.5	29	58.1	2.35	29.0	58.03	0.15	-0.04	0.00
46+200.7	415	65	19.5	4.5	71.3	141.3	4.52	71.3	141.21	0.00	-0.03	0.00
46+423.6	550	65	24.7	3.4	121	236.7	3.41	121	236.60	0.00	-0.02	0.00
46+676.9	920	65	10.8	2.5	87.1	173.8	2.04	87.1	173.68	0.46	-0.04	0.00

47+057.3	800	65	7.7	2.5	53.7	107.3	2.35	53.8	107.28	0.15	-0.05	0.00
47+153.1	400	65	6.7	4.7	23.5	46.9	4.69	23.5	46.92	0.00	0.00	0.00
47+238.4	760	65	6.0	2.5	39.9	79.7	2.47	39.9	79.67	0.03	0.01	0.00
47+339.9	500	65	7.8	3.7	34	68	3.76	34.0	67.94	0.00	-0.04	0.00
47+436	1500	65	1.1	2.5	14.3	28.6	1.25	14.3	28.56	1.25	0.01	0.00
47+545.5	755	65	4.8	2.5	31.9	63.8	2.49	31.9	63.75	0.01	-0.01	0.00
47+767.7	160	65	54.2	7	102	111.2	7.00	81.8	151.14	-4.74	20.2	0.00
48+052.9	320	65	44.4	5.9	131	248	5.87	131	247.91	0.00	-0.02	0.00
42+475.3	350	65	16.9	5.3	52.1	103.4	5.37	52.1	103.37	0.00	0.01	0.00
48+365.1	800	65	15.1	2.5	106	211.5	2.35	106	211.35	0.15	-0.05	0.00
48+781.2	1000	65	6.4	2.5	56.1	112.1	1.88	56.1	112.01	0.62	0.01	0.00
48+903.7	301	65	12.5	6.2	33	65.7	6.24	33.0	65.71	0.00	0.00	0.00
48+985.2	400	65	9.5	4.7	33.1	66.1	4.69	33.1	66.11	0.00	-0.04	0.00
49+101.4	2500	65	1.2	2.5	26.4	52.8	0.75	26.4	52.80	1.75	-0.01	0.00
49+155.4	1000	65	1.4	2.5	12.4	24.9	1.88	12.5	24.88	0.62	-0.05	0.00
49+283.2	760	65	16.6	2.5	111	220.1	2.47	111	220.03	0.03	-0.05	0.00
49+608.4	760	65	27.3	2.5	184	361.6	2.47	184	361.39	0.03	0.02	0.00
49+936.1	760	65	13.0	2.5	86.8	172.8	2.47	86.8	172.69	0.03	0.04	0.00
50+234.3	250	40	37.2	2.8	104	122.3	2.84	84.1	162.21	0.00	20.1	-39.91
50.665.7	292	40	23.3	2.5	60.2	118.6	2.44	60.1	118.58	0.06	0.05	0.00

50+855.8	350	65	27.6	5.4	85.9	168.5	5.37	85.9	168.40	0.00	-0.01	0.00
51+256.8	302	65	27.8	6.2	94.7	106.3	6.22	74.6	146.25	0.00	20.1	-40.00
51+515.9	760	65	18.3	2.5	123	243.3	2.47	123	243.14	0.03	0.02	0.00
51+837.4	1000	65	12.4	2.5	108	215.8	1.88	108	215.65	0.62	0.00	0.00
52+125.2	2000	65	2.4	2.5	41.8	83.5	0.94	41.7	83.45	1.56	0.05	0.00
52+374.2	475	65	4.4	4.0	18.2	36.3	3.95	18.2	36.33	0.00	0.02	0.00
52+447.6	301	65	5.0	6.2	13.2	26.3	6.24	13.1	26.30	0.00	0.04	0.000
RHS												
20+295.2	90.8	50	102	7.0	112.	161.8	7.00	112	161.81	0.00	-0.04	-0.01
20+456.1	80.8	45	104	7.0	104	147	7.0	104	147.07	0.00	-0.05	-0.07

20+575.3	78	20	85.8	2.5	72.5	116.8	2.2	72.5	116.77	0.22	-0.01	0.03
20+682.7	126	50	51.9	7.0	61.3	114.1	7.0	61.3	114.12	0.00	-0.05	-0.02
20+827.3	96.5	50	86.1	7.0	90.2	145.1	7.0	90.2	145.01	0.00	-0.01	0.09
21+017.2	69.3	40	49.4	7.0	31.9	59.8	7.0	31.9	59.80	0.00	-0.02	0.00
22+552.1	116	40	170	6.1	1351	343.6	6.2	1352	343.55	0.00	-0.60	0.05
21+653.2	143	40	39.8	4.9	51.8	99.4	4.9	51.8	99.32	0.00	0.01	0.08
21+849.9	120	50	49.3	7.0	55	103.1	7.0	54.9	103.07	0.00	0.01	0.03
22+139.4	720	65	23.4	2.6	149	294.2	2.6	149	294.07	0.00	0.01	0.13
22+477	23	50	40.1	4.6	87.1	167	4.6	87.1	166.95	0.00	-0.01	0.05
22+602.3	500	50	0.52	2.5	2.3	4.6	2.2	2.31	4.61	0.28	-0.01	-0.01
22+673.8	300	65	3.58	6.3	9.4	18.8	6.2	9.38	18.74	0.00	0.02	0.06
22+717	450	65	4.53	4.1	17.8	35.6	4.1	17.8	35.58	0.00	-0.01	0.02
22+851	155	65	35.7	7.0	49.9	96.5	7.0	49.9	96.47	0.00	0.02	0.03
23+099.6	1000	65	0.97	2.5	8.5	16.9	1.8	8.47	16.94	0.62	0.03	-0.04
23+660.3		65	6.89	7.0	12	24	7.0	12.0	23.98	0.00	-12	0.02
23+976.9	200	65	18.5	7.0	60.2	9.7	7.0	32.6	64.63	0.00	28.2	-9.43
24+307.1	84.3	45	54.9	7.0	71.9	25.6	7.0	43.8	80.80	0.00	28.1	-55.20
24+857.7	112	50	89.3	7.0	129	139.7	7.0	111	174.59	0.00	17.9	-34.89
30+567	149	50	169	7.0	1501	409	7.0	1485	438.88	0.00	17.0	-29.88
30+868	320	65	9.28	5.8	26	51.8	5.8	25.9	51.81	0.00	0.02	-0.01
30+969.7	300	50	14.7	3.7	38.8	77.2	3.7	38.8	77.16	0.00	-0.01	0.04
34+949.7	450	65	10.8	4.1	42.7	85.1	4.1	42.7	85.11	0.00	0.00	-0.01
35+067.3	500	40	7.29	2.5	31.9	63.7	1.4	31.8	63.66	1.08	0.01	0.04
35+366.2	520	40	29.0	2.5	135	263.8	1.3	1347	263.62	1.13	0.02	0.18
35+892.5	301	50	65.9	3.7	195	346.3	3.6	195	346.10	0.00	-0.05	0.20
35+938.1	160	65	40.3	7.0	78.9	72.6	7.0	58.7	112.54	0.00	20.5	-39.94

36+484.5	759	65	4.3	-2.5	28.7	57.4	2.48	28.7	57.37	0.00	-0.01	0.00
36+595.9	760	65	9.5	-2.5	63.4	126.4	2.47	63.4	126.36	0.00	0.04	0.00
36+736.3	200	65	24.7	7	43.8	86.2	7.00	43.8	86.17	-2.39	0.01	0.00
36+923.1	157	65	59.5	7	89.5	162.5	7.00	89.5	162.46	-5.00	0.04	0.00

37+171.1	262	65	48.1	7	117	219.8	7.00	117	219.68	-0.17	-0.03	0.00
37+371.9	-203	65	23.2	7	41.8	82.4	-9.25	-41.7	-82.32	16.2	83.6	0.00
37+510.7	197	65	24.1	7	42.1	83	7.00	42.1	82.97	-2.53	-0.03	0.00
37+858.9	152	65	42.6	7	59.1	112.7	7.00	59.1	112.68	-5.39	-0.02	0.00
38+366.7	-205	65	32.9	7	60.6	117.8	-9.16	-60.5	-117.7	16.2	121	0.00
38+524.8	300	65	17.7	6.3	46.7	92.6	6.26	46.6	92.44	-0.01	0.08	0.00
38+723.8	337	65	44.4	5.5	138	261.4	5.57	138	261.24	-0.07	0.04	0.00
39+030	300	65	20.3	6.3	73.9	66.8	6.25	53.9	106.65	20.0	19.9	-40.05
39+306	199	65	27.8	7	49.2	96.4	7.00	49.2	96.33	0.00	0.04	0.00
39+788.6	281	65	39.7	6.7	122	155	6.68	102	194.75	20	20.1	40
39+919.8	760	65	0.6	-2.5	4.2	8.4	2.47	4.22	8.43	0.00	-0.02	0.00
39+954.8	400	45	6.5	2.5	22.7	45.3	2.25	22.7	45.28	0.25	0.02	0.00
40+048	200	45	12.8	2.5	22.4	44.6	4.50	22.4	44.60	-2.00	0.00	0.00
40+187.6	245	65	22.0	7	47.6	94	7.00	47.5	93.90	-0.66	0.00	0.00
40+281.2	760	65	2.0	-2.5	13.5	27	2.47	13.5	27.03	0.03	-0.02	0.00
40+412.2	301	65	29.1	6.2	78.2	153	6.24	78.6	152.89	0.00	0.03	0.00
40+635.3	899	65	10.3	-2.5	81.1	161.7	2.09	81.1	161.60	0.00	0.04	0.00
41+023.7	300	65	23.1	2.5	61.5	121.3	6.25	61.5	121.20	-3.75	0.03	0.00
41+342.5	251	65	27.0	7	60.3	118.4	7.00	60.3	118.37	-0.48	-0.04	0.002
41+850.3	399	65	16.1	4.7	56.3	111.9	4.71	56.3	111.89	0.00	0.00	0.00
42+024	303	65	17.8	6.2	47.2	93.7	6.21	47.2	93.68	0.00	-0.04	0.00
42+205.9	1002	65	6.4	-2.5	56.1	112.1	1.87	56.1	112.04	0.00	-0.01	0.00
42+421.9	800	65	13.2	-2.5	92.3	183.8	2.35	92.3	183.67	0.00	0.01	0.00
42+614.2	762	65	5.6	-2.5	37.5	74.9	2.47	37.5	74.82	0.00	0.04	0.00
42+887.3	762	65	7.5	-2.5	50.1	100.1	2.47	50.1	100.03	0.00	-0.01	0.00
42+997.3	400	65	8.9	4.7	31.1	62	4.69	31.1	62.00	0.00	0.02	0.00
43+227.1	502	65	13.7	3.7	60.1	119.7	3.74	60.1	119.64	0.00	-0.04	0.00
43+420	499	65	19.7	3.8	86.4	171	3.77	86.4	170.94	0.00	0.04	0.00
43+661.5	402	65	26.7	4.7	95.4	187.2	4.68	95.4	187.14	0.00	0.05	0.00
43+939.4	799	65	12.0	2.5	84.2	167.7	2.35	84.2	167.66	0.15	0.02	0.00

44+165.2	307	65	18.1	6.1	48.8	96.9	6.13	48.9	96.83	0.00	-0.05	0.00
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44+529.4	999	65	13.6	2.5	119	237.2	1.88	119	237.09	0.62	0.03	0.00
44+836.2	602	65	16.4	3.1	86.5	171.8	3.12	86.5	171.74	0.00	0.00	0.00
45+025.7	759	65	8.1	2.5	53.6	107	2.48	53.6	106.91	0.02	0.03	0.00
45+401.5	802	65	20.5	2.5	145	286.1	2.34	145	285.99	0.16	-0.01	0.00
45+621.1	499	65	16.3	3.8	71.4	141.8	3.77	71.4	141.71	0.00	0.03	0.00
45+808.3	502	65	12.5	3.7	54.8	109.1	3.74	54.8	109.06	0.00	0.02	0.00
45+881.4	1005	65	0.7	2.5	5.8	11.6	1.87	5.80	11.60	0.63	0.00	0.00
45+988.5	805	65	4.2	2.5	29.2	58.4	2.33	29.2	58.40	0.17	-0.03	0.00
46+187.1	400	65	18.7	4.7	65.9	130.7	4.69	65.9	130.64	0.00	-0.04	0.00
46+411.8	553	65	23.9	3.4	117	230.4	3.40	117	230.33	0.00	-0.02	0.00
46+658.6	917	65	10.8	2.5	86.9	173.2	2.05	86.9	173.11	0.45	0.04	0.00
47+025.6	797	65	7.7	2.5	53.5	106.9	2.36	53.6	106.88	0.14	-0.05	104.54
47+136.5	405	65	6.7	4.6	23.9	47.7	4.64	23.9	47.63	0.00	0.04	43.06
47+221.6	755	65	6.0	2.5	39.9	79.7	2.49	39.9	79.66	0.01	0.01	77.21
47+322.9	455	65	9.0	4.1	35.8	71.4	4.13	35.8	71.39	0.00	0.01	67.27
47+419.6	2500	65	0.1	2.5	2	4	0.75	2.02	4.04	1.75	-0.02	3.25
47+529	752	65	4.8	2.5	31.8	63.5	2.50	31.8	63.49	0.00	0.02	0.00
47+752.5	163	65	54.1	7	104	113.4	7.00	83.2	153.71	-4.52	20.4	0.00
48+040.6	319	65	44.3	5.9	130	246.3	5.90	130	246.20	0.00	0.01	0.00
48+349.7	802	65	14.6	2.5	103	204.8	2.34	103	204.74	0.16	0.01	0.00
48+764.8	1300	65	6.9	2.5	78.1	156.1	1.44	78.1	155.98	1.06	-0.03	0.00
48+889.7	306	65	12.6	6.1	33.7	67	6.14	33.7	67.00	0.00	0.05	0.00
48+972.1	405	65	9.6	4.6	34.1	68.1	4.64	34.1	68.09	0.00	-0.04	0.00
49+269.3	763	65	16.6	2.5	112	221.7	2.46	112	221.58	0.04	-0.03	0.00
49+595.9	757	65	27.3	2.5	184	360.1	2.48	184	359.96	0.02	-0.05	0.00
49+923.3	763	65	13.0	2.5	87	173.3	2.46	87.0	173.20	0.04	-0.02	0.00
50+223.4	249	40	37.2	2.9	104	121.4	2.86	83.6	161.18	0.00	20.0	-20.0
50+652	289	65	23.3	2.5	59.5	117.4	6.50	59.5	117.36	-4.00	-0.03	0.00
50+842.1	349	65	27.6	5.4	85.5	167.8	5.39	85.5	167.68	0.00	-0.04	0.00

51+242.3	301	65	27.8	6.3	94.2	105.7	6.25	74.2	145.50	0.00	20	-40.45
51+501.3	758	65	18.3	2.5	122	242.6	2.48	122	242.44	0.02	-0.02	0.00
51+822.9	999	65	12.4	2.5	108	215.4	1.88	108	215.32	0.62	-0.04	0.00
52+110.6	1500	65	2.4	2.5	31.3	62.6	1.25	31.3	62.59	1.25	-0.02	0.00
52+359.7	477	65	2.1	3.9	8.6	17.3	3.94	8.63	17.24	0.00	-0.03	0.00
52+433.6	306	65	7.3	6.2	19.5	39	6.15	19.5	39.00	0.00	-0.04	0.00
40+187.6	245	65	22.0	7	47.6	94	7.00	47.5	93.90	-0.66	0.00	0.00

40+281.2	760	65	2.0	-2.5	13.5	27	2.47	13.5	27.03	0.03	-0.02	0.00
40+412.2	301	65	29.1	6.2	78.2	153	6.24	78.6	152.89	0.00	0.03	0.00
40+635.3	899	65	10.3	-2.5	81.1	161.7	2.09	81.1	161.60	0.00	0.04	0.00
41+023.7	300	65	23.1	2.5	61.5	121.3	6.25	61.5	121.20	-3.75	0.03	0.00
41+342.5	251	65	27.0	7	60.3	118.4	7.00	60.3	118.37	-0.48	-0.04	0.002
41+850.3	399	65	16.1	4.7	56.3	111.9	4.71	56.3	111.89	0.00	0.00	0.00
42+024	303	65	17.8	6.2	47.2	93.7	6.21	47.2	93.68	0.00	-0.04	0.00
42+205.9	1002	65	6.4	-2.5	56.1	112.1	1.87	56.1	112.04	0.00	-0.01	0.00
42+421.9	800	65	13.2	-2.5	92.3	183.8	2.35	92.3	183.67	0.00	0.01	0.00
42+614.2	762	5	5.6	-2.5	37.5	74.9	2.47	37.5	74.82	0.00	0.04	0.00
42+887.3	762	65	7.5	-2.5	50.1	100.1	2.47	50.1	100.03	0.00	-0.01	0.00
42+997.3	400	65	8.9	4.7	31.1	62	4.69	31.1	62.00	0.00	0.02	0.00
43+227.1	502	65	13.7	3.7	60.1	119.7	3.74	60.1	119.64	0.00	-0.04	0.00
43+420	499	65	19.7	3.8	86.4	171	3.77	86.4	170.94	0.00	0.04	0.00
43+661.5	402	65	26.7	4.7	95.4	187.2	4.68	95.4	187.14	0.00	0.05	0.00
43+939.4	799	65	12.0	2.5	84.2	167.7	2.35	84.2	167.66	0.15	0.02	0.00
44+165.2	307	65	18.1	6.1	48.8	96.9	6.13	48.9	96.83	0.00	-0.05	0.00
44+529.4	999	65	13.6	2.5	119	237.2	1.88	119	237.09	0.62	0.03	0.00
44+836.2	602	65	16.4	3.1	86.5	171.8	3.12	86.5	171.74	0.00	0.00	0.00
45+025.7	759	65	8.1	2.5	53.6	107	2.48	53.6	106.91	0.02	0.03	0.00
45+401.5	802	65	20.5	2.5	145	286.1	2.34	145	285.99	0.16	-0.01	0.00
45+621.1	499	65	16.3	3.8	71.4	141.8	3.77	71.4	141.71	0.00	0.03	0.00
45+808.3	502	65	12.5	3.7	54.8	109.1	3.74	54.8	109.06	0.00	0.02	0.00

45+881.4	1005	65	0.7	2.5	5.8	11.6	1.87	5.80	11.60	0.63	0.00	0.00
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Table A.2 Data Check for Horizontal Curves from 0.00 to16+700 UBP (LHS &RHS)

Given Value					Designed Value			Calculated Value			Difference in Values		
CH (m)	Side	V K m/ hr.	R (m)	Δ (°)	e %	Ts m	Lc m	e %	Ts m	Lc m	e %	Ts m	Lc m
0+787	RHS	65	995.5	1.6	2.5	13. 7	27.4	1.8 8	14	27	0.6	0	0
0+856	LHS	65	1000	1.9	2.5	16. 3	32.6	7.0 0	16	33	-4.5	0	0

1+059	RHS	65	200	40	7	71. 6	137. 5	7.0 0	72	137	0.0	0	0
1+061	LHS	65	145	40	-7	52. 6	101	7.0 0	53	101	0.0	0	0
1+063	LHS	65	240	41	-7	110	132. 1	7.0 0	90	172	0.0	20	-40
1+063	RHS	65	244.5	41	7	135	111. 4	3.1 3	91	175	3.9	43	-63
1+242	LHS	65	600	9.8	3.1	51. 3	102. 3	3.1 3	51	102	0.0	0	0
1+245	RHS	65	600	10	3.1	53. 5	106. 7	4.7 5	53	107	-1.6	0	0
1+434	RHS	65	395.5	23	4.7	91. 6	131. 1	4.6 9	79	156	0.1	12	-25
1+435	LHS	65	400	23	4.7	91. 7	131. 4	7.0 0	80	158	-2.3	12	-26
1+908	LHS	65	155.6	33	2.5	59. 1	90.1	7.0 0	46	90	-4.5	13	0
1+915	RHS	65	160	33	-7	46. 4	92.7	7.0 0	48	93	0.0	-1	0
2+066	RHS	65	240.5	11	7	22. 6	45.1	7.0 0	23	45	0.0	0	0
2+040	LHS	65	245	11	7	23. 1	46.0	7.0 0	23	46	0.0	0	0
2+184	RHS	65	160	18	-7	25. 2	50.1	7.0 0	25	50	0.0	0	0
2+185	RHS	65	164.5	18	7	26	51.5	3.1 3	26	51	3.9	0	0
2+484	RHS	65	600	21	4.7	109.	216. 2	3.1 3	109	216	1.6	0	0
0+856	LHS	65	1000	1.9	2.5	16. 3	32.6	7.0 0	16	33	-4.5	0	0
1+059	RHS	65	200	40	7	71. 6	137. 5	7.0 0	72	137	0.0	0	0
1+061	LHS	65	145	40	-7	52. 6	101	7.0 0	53	101	0.0	0	0

1+063	LHS	65	240	41	-7	110	32. 1	7.0 0	90	172	0.0	20	-40
1+063	RHS	65	244.5	41	7	135	111. 4	3.1 3	91	175	3.9	43	-63
1+242	LHS	65	600	9.8	3.1	51. 3	102. 3	3.1 3	51	102	0.0	0	0
1+245	RHS	65	600	10	3.1	53. 5	106. 7	4.7 5	53	107	-1.6	0	0
1+434	RHS	65	395.5	23	4.7	91. 6	131. 1	4.6 9	79	156	0.1	12	-25
1+435	LHS	65	400	23	4.7	91. 7	131. 4	7.0 0	80	158	-2.3	12	-26
1+908	LHS	65	155.6	33	2.5	59. 1	90.1	7.0 0	46	90	-4.5	13	0
1+915	RHS	65	160	33	-7	46. 4	92.7	7.0 0	48	93	0.0	-1	0
2+066	RHS	65	240.5	11	7	22. 6	45.1	7.0 0	23	45	0.0	0	0
2+040	LHS	65	245	11	7	23. 1	46.0	7.0 0	23	46	0.0	0	0
2+184	RHS	65	160	18	-7	25. 2	50.1	7.0 0	25	50	0.0	0	0
2+185	RHS	65	164.5	18	7	26	51.5	3.1 3	26	51	3.9	0	0
2+484	RHS	65	600	21	4.7	109.	216. 2	3.1 3	109	216	1.6	0	0
2+483	LHS	65	600	21	4.7	109	216. 3	7.0 0	109	216	-2.3	0	0
2+759	LHS	50	135	90	3.6	135	212. 0	7.0 0	135	212	-3.4	0	0
2+781	RHS	60	145	92	7	151	233. 7	2.6 7	151	234	4.3	0	0
3+075	RHS	60	600	4.5	2.7	23. 8	47.5	1.8 5	24	47	0.8	0	0
3+009	LHS	50	600	2.3	2.5	12. 1	24.1	5.3 7	12	24	-2.9	0	0

10+639	LHS	65	350	36	5.3	133	178. 3	5.4 4	113	218	-0.1	20	-40
10+653	RHS	65	345	35	5.4	131	175. 4	6.2 4	111	215	-0.8	20	-40
10+965	LHS	65	301	30	6.2	100	116. 4	6.1 5	80	156	0.1	20	-40
10+979	RHS	65	305.5	30	6.1	101	118. 8	4.6 9	81	159	1.5	20	-40
11+352	LHS	65	400	27	4.7	95. 1	186. 8	4.6 9	95	187	0.0	0	0
11+366	LHS	65	400	27	4.7	94. 6	185. 7	3.7 6	95	186	0.9	0	0
11+40	LHS	65	500	9.7	3.7	42. 4	84.5	6.2 4	42	84	-2.5	0	0
11+43	RHS	65	301	22	6.2	59	116. 5	7.0 0	59	116	-0.8	0	0
11+718	RHS	40	85	79	7	69. 5	116. 4	6.2 4	69	116	0.8	0	0
11+726	LHS	65	301	21	6.2	56. 9	112. 4	7.0 0	57	112	-0.8	0	0
11+843	RHS	50	101	25	7	22. 8	44.8	6.2 4	23	45	0.8	0	0

12+085	RHS	65	285	32	6.5	97. 5	130. 4	7.0 0	82	160	-0.4	15	-30
12+268	LHS	50	100	69	7	89. 6	81	7.0 0	69	121	0.0	20	-40
12+331	RHS	50	104.5	69	7	92. 4	86.0 2	7.0 0	72	126	0.0	20	-40
12+525	LHS	60	145.5	58	7	80. 7	147. 3	7.0 0	81	147	0.0	0	0
12+579	RHS	60	1140	56	7	75. 1	137. 9	3.1 3	75	138	3.9	0	0
12+48	LHS	65	600	22	3.1	115	227	3.1 3	115	227	0.0	0	0
12+803	RHS	65	600	23	3.1	122	239. 6	6.2 4	121	240	-3.1	0	0
12+997	LHS	65	301	26	6.2	88. 2	94	6.0 6	68	134	0.2	20	-40
13+055	RHS	65	310	25	6.0	89. 4	96.4 3	6.2 4	69	136	-0.2	20	-40
13+195	LHS	65	301	19	624	50. 4	99.9	6.2 4	50	100	618	0	0
13+258	RHS	65	301	22	6.2	57. 2	113. 0	2.3 5	57	113	3.9	0	0
13+341	LHS	65	800	6.2	2.5	43. 6	87.1	2.3 5	44	87	0.2	0	0
13+394	RHS	65	800	4.0	2.5	27. 6	55.2 1	7.0 0	28	55	-4.5	0	0
13+576	LHS	50	105	44	7	42. 8	81.3	7.0 0	43	81	0.0	0	0
13+634	RHS	40	85.5	44	7	34. 7	65.9 4	7.0 0	35	66	0.0	0	0
13+761	LHS	60	150	61	7	109	120. 5	7.0 0	89	160	0.0	20	-40
13+814	RHS	65	155	61	7	112	125. 8	7.0 0	92	166	0.0	20	-40
14+55	LHS	50	100	65	7	84. 2	73.6	7.0 0	64	114	0.0	20	-40
14+213	RHS	50	104	65	7	86. 7	78.1 4	4.1 7	66	118	2.8	20	-40
14+470	LHS	65	450	25	4.2	119	155. 7	4.2 1	99	196	0.0	20	-40
14+530	RHS	65	445.5	25	4.2	118	153. 7	7.0 0	98	194	-2.8	20	-40
14+845	LHS	65	250	58	7	160	214. 6	7.0 0	10	254	0.0	20	-40
14+901	LHS	65	245.5	58	7	157	210. 1	7.0 0	137	250	0.0	20	-40
15+179	LHS	65	200	35	7	123	7	7.0 0	63	123	0.0	59	-116
15+226	RHS	65	200	35.	7	63. 4	122. 7	7.0 0	63	123	0.0	0	0
15+700	LHS	65	240	72	7	193	260. 1	7.0 0	173	300	0.0	20	-40
15+704	RHS	65	244.5	72	7	197	265. 7	3.1 3	16	306	3.9	20	-40
15+940	LHS	65	600	8.8	3.1	58. 7	67.3	3.1 1	46	92	0.0	12	-25

15+999	RHS	65	604.5	8.8	3.1	58.9	67.53	7.00	46	92	-3.9	13	-25
16+256	LHS	60	140	45	7	58.5	110.9	7.00	59	111	0.0	0	0

Table A.3 Data Check for Horizontal Curves from 18.000 to 20.000 Nagrota Bypass (LHS &RHS)

Given Value				Designed Value			Calculated Value			Difference in values			
LHS													
CH (m)	Side	V K m/ hr.	R (m)	Δ (°)	e %	Ts m	Lc m	e %	Ts m	Lc m	e %	Ts m	
18+680	61.4	50	90	7.0	92	21.6	7	53.52	96.5	0.00	38.7	-74.9	
18+895	25.2	60	251	4.2	55	111	6.4	56.22	111	-2.2	-0.00	0.04	
19+021	19.8	60	175	6.4	31	60.5	7.0	30.57	60.4	-0.6	0.03	0.01	
19+104	9.28	65	500	3.7	41	81	3.8	40.57	80.9	0.0	0.03	0.08	
19+281	13.2	65	505	2.5	58	117	3.7	58.72	117	-1.2	0.00	0.03	
19+433	4.13	50	400	2.7	14	28.8	2.8	14.43	28.8	0.0	-0.03	0.01	
19+498	26.3	50	95	7.0	22.	43.7	7.0	22.26	43.7	0.0	0.04	0.02	
RHS													
18+671	57.4	50	90	7.0	88	15.2	7.0	49.31	90.1	0.0	38.6	-74.9	
18+876	20.4	65	250	7.0	45	89.1	7.0	44.98	88.9	0.0	0.02	0.15	
19+002	20.4	50	150	4.4	27	53.5	7.0	27.03	53.4	-2.6	-0.03	0.05	

19+087	9.30	50	500	2.5	41	81.2	2.2	40.68	81.1	0.3	0.02	0.06	
19+280	12.0	50	29	5.3	31	62.5	3.7	31.36	62.4	1.6	0.04	0.03	

19+41 7	4.4 7	60	40 0	4.0	16	31.2	4. 0	15.61	31. 2	0.0	- 0.01	0.01
19+48 2	26. 0	50	95	7.0	22	43.3	7. 0	22.01	43. 2	0.0	- 0.01	0.03

Table A.5 Data checking for vertical curves of LHS & RHS of Jammu & Udhampur Main Road from 20.000 km to 52.000 km.

Chainage	Type of curve	Design speed (v)	Gradient In (n ₁)	Gradient Out (n ₂)	Grade Difference N= (n ₁ +n ₂)	Curve Length (Given)	Curve Length (cal.)	Curve Length (Diff.)
LHS								
20.605	s	65	-0.7	3.5	2.76	50	51	-1.00
20.815	v	65	-1.1	3.6	2.45	110	45	65.00
21.16	s	65	-4.3	3.1	-1.22	60	40	20.00
21.43	v	65	-3.1	4.5	1.33	100	40	60.00
21.6	s	65	-5.1	3.3	-1.79	90	40	50.00
22.01	v	65	-4.5	5.1	0.63	60	40	20.00
22.295	s	65	-4.4	2.1	-2.29	350	42	308.00
22.71	v	65	-2.9	2.1	-0.79	100	40	60.00
23.09	s	65	-3.4	2.3	-1.09	100	40	60.00
23.61	v	65	-1.3	4.5	3.23	100	60	40.00
24.065	s	65	-3.5	1.8	-1.77	150	40	110.00
24.47	v	65	-0.7	2.0	1.31	80	40	40.00
24.73	s	65	-2.2	0.8	-1.33	120	40	80.00

24.945	v	65	-1.2	3.2	1.99	90	40	50.00
26.79	v	65	-1.1	2.9	1.79	100	40	60.00

26.98	s	65	-2.8	1.0	-1.84	120	40	80.00
27.415	s	65	0.0	-0.5	-0.47	350	40	310.00
27.76	v	65	0.5	-0.6	-0.03	100	40	60.00
27.99	v	65	0.4	-0.2	0.21	120	40	80.00
28.65	s	65	1.1	-3.4	-2.27	420	40	380.00
29.08	v	65	3.7	-2.0	1.74	100	40	60.00
29.63	s	65	1.7	-3.9	-2.21	180	40	140.00

31.223	v	65	3.9	-1.2	2.73	125	51	74.00
32.125	s	65	-4.8	3.1	-1.73	150	40	110.00
34.94	v	65	-2.4	1.4	-1.01	80	40	40.00
35.073	v	65	-4.0	5.1	1.10	115	40	75.00
35.455	v	65	-3.5	0.9	-2.58	150	48	102.00
35.74	v	65	-0.4	1.4	0.96	60	40	20.00
41.06	s	65	0.2	-0.6	-0.43	60	40	20.00
41.163	v	65	-0.4	-0.3	-0.71	125	40	85.00
41.363	s	65	-2.5	0.3	-2.17	165	40	125.00
41.645	s	65	0.5	-1.4	-0.94	150	40	110.00
41.81	v	65	0.8	1.1	1.95	100	40	60.00
42.135	s	65	-1.6	0.5	-1.13	190	40	150.00
42.37	v	65	-0.9	2.4	1.43	100	40	60.00
42.593	s	65	-2.3	0.9	-1.43	175	40	135.00
42.95	v	65	-3.2	1.4	-1.81	100	40	60.00
43.325	s	65	-2.9	0.2	-2.68	210	40	170.00
43.585	v	65	0.5	0.9	1.44	90	40	50.00
43.878	s	65	-1.1	1.0	-0.19	145	40	105.00
44.14	v	65	-2.6	1.1	-1.50	150	40	110.00
44.31	v	65	-1.9	2.2	0.24	100	40	60.00
44.86	s	65	-2.8	1.4	-1.38	320	40	280.00

45.22	v	65	-1.5	3.1	1.62	100	40	60.00
45.58	s	65	-3.0	2.4	-0.63	90	40	50.00
45.825	s	65	-0.1	-2.4	-2.52	250	40	210.00
46.155	v	65	3.3	-2.7	0.55	125	40	85.00
46.565	s	65	2.0	-4.3	-2.23	150	40	110.00
47.100	v	65	3.5	-2.0	1.50	100	40	60.00
48.600	v	65	2.5	-1.4	1.18	200	40	160.00
48.335	s	65	1.3	-3.4	-2.01	180	40	140.00
48.605	v	65	3.2	-2.3	0.94	200	40	160.00
49.000	s	65	2.5	-3.6	-1.16	250	40	210.00
50.155	v	65	3.4	-1.6	1.85	220	40	180.00
51.735	s	65	1.2	-3.6	-2.39	160	40	120.00
52.135	v	65	2.6	-0.8	1.81	90	40	50.00

Table A.6 Data checking for vertical curves of RHS of Jammu & Udhampur Main Road NH 1A from 20.000 km to 52.000 km.

Chainage	Type of curve	Design Speed (v)	Gradient In (n ₁)	Gradient Out (n ₂)	Grade Difference N= (n ₁ +n ₂)	Curve Length (Given)	Curve Length (cal.)	Curve Length (Diff.)
20.62	S	65	-3.6	0.8	-2.82	60	52	8.00
20.78	V	65	-1.2	5.4	4.18	110	77	33.00
21.18	S	65	-4.3	4.8	0.59	60	40	20.00
21.44	V	65	-2.6	4.5	1.96	100	40	60.00
21.615	S	65	-1.5	2.8	1.29	90	40	50.00
21.96	V	65	-3.7	2.3	-1.39	60	40	20.00
22.225	S	65	-4.6	2.5	-2.11	350	40	310.00
22.72	V	65	-2.0	3.3	1.35	100	40	60.00
23.085	S	65	-3.5	2.2	-1.28	100	40	60.00

24.085	S	65	-2.9	1.0	-1.95	150	40	110.00
24.52	V	65	-0.7	2.1	1.43	80	40	40.00
24.76	S	65	-2.3	1.0	-1.32	120	40	80.00
24.95	V	65	-1.1	3.1	1.98	90	40	50.00
26.8	V	65	-1.4	2.5	1.12	100	40	60.00

26.98	S	65	-2.9	1.5	-1.36	120	40	80.00
27.81	V	65	0.3	-0.3	0.04	300	40	260.00
28.65	S	65	1.1	-3.4	-2.26	420	42	378.00
29.08	V	65	3.7	-1.9	1.78	100	40	60.00
29.63	S	65	2.0	-3.9	-1.89	180	40	140.00
31.233	V	65	3.4	-1.3	2.13	125	40	85.00
32.145	S	65	-4.4	3.0	-1.43	150	40	110.00
35.055	V	65	-3.2	5.4	2.20	150	41	109.00
35.245	S	65	-5.7	4.9	-0.78	80	40	40.00
35.445	S	65	-3.3	1.2	-2.11	150	40	110.00
35.73	V	65	-0.2	1.2	0.98	60	40	20.00
36+450	S	65	-3.2	2.5	-0.71	150	40	110.00
36+750	S	65	-2.1	1.3	-0.79	100	40	60.00
37+710	S	65	-2.9	1.9	-1.01	150	40	110.00
39+153	S	65	-3.5	-0.2	-3.63	306	67	239.00
40+110	S	65	-1.9	1.1	-0.80	60	40	20.00

40+350	S	65	-0.6	0.0	-0.63	60	40	20.00
40+610	S	65	0.3	-1.4	-1.17	60	40	20.00
36+650	V	65	-2.7	1.2	-1.49	100	138	-38.00
36+910	V	65	-3.7	0.0	-3.71	100	69	31.00
37+975	V	65	-2.1	3.3	1.19	200	40	160.00
38+760	V	65	-4.3	5.2	0.92	200	40	160.00
39+380	V	65	1.4	1.2	2.58	120	48	72.00
40+790	V	65	1.1	-0.3	0.83	60	40	20.00

41.145	V	65	-0.7	4.0	3.25	150	60	90.00
41.35	S	65	-3.4	1.1	-2.33	140	43	97.00
41.62	S	65	0.8	-1.9	-1.15	80	40	40.00
41.79	V	65	1.3	0.4	1.67	100	40	60.00
41.95	V	65	-1.6	2.1	0.59	60	40	20.00
42.19	S	65	-1.7	0.8	-0.90	60	40	20.00
42.33	V	65	-0.9	2.4	1.46	100	40	60.00
42.55	S	65	-2.3	1.0	-1.37	100	40	60.00
42.915	V	65	-0.8	2.1	1.30	110	40	70.00
43.13	S	65	-2.2	2.0	-0.18	260	40	220.00
43.883	S	65	-1.1	0.5	-0.59	145	40	105.00
44.2	V	65	-1.3	2.4	1.10	100	40	60.00
44.3	S	65	-3.7	3.6	-0.14	60	40	20.00
45.21	V	65	-1.2	2.9	1.74	100	40	60.00
45.715	S	65	-2.2	-1.2	-3.39	350	63	287.00
46.545	S	65	4.7	-2.8	1.90	150	40	110.00
47.46	V	65	5.3	-3.7	1.65	60	40	20.00
47.93	V	65	2.6	-1.7	0.93	295	40	255.00
48.33	S	65	1.6	-3.4	-1.77	180	40	140
48.6	V	65	3.2	-2.1	1.05	200	40	160
49.255	S	65	1.8	-3.9	-2.10	250	40	210
50.16	V	65	3.5	-1.7	1.74	220	40	180
51.722	S	65	1.0	-3.2	-2.12	155	40	115
52.194	V	65	-1.4	4.9	3.46	107	64	43

Table A.7 data checking for vertical curves of LHS &RHS of Jammu bypass 15.200 km to 19.000 km.

Chainage	TYP E OF CUR VE	Design speed (v)	Gradient In (n ₁)	Gradient Out (n ₂)	Grade Difference N= (n ₁ +n ₂)	Curve Length (Given)	Curve Length (cal.)	Curve Length (Diff.)
LHS								
16.115	V	65	2.9	-1.2	1.64	350	40	310
16.895	S	65	1.7	-4.2	-2.52	200	48	152
17.18	V	65	4.3	-1.4	2.95	120	55	65
17.54	V	65	-1.1	2.7	1.56	120	40	80
17.992	V	65	-3.1	0.4	-2.78	145	52	93
18.56	V	65	-1.9	4.1	2.22	117.55	41	76.55
RHS								
16.615	V	65	4.1	-0.6	3.60	180	64	116
16.89	S	65	1.9	-4.2	-2.32	200	44	156
17.215	V	65	4.4	-1.0	3.35	130	61	69
17.54	V	65	-1.0	2.8	1.79	120	40	80
17	S	65	-2.7	0.9	-1.82	160	40	120
18.545	V	65	-1.2	3.4	2.18	90	40	50

Table A.8 Data checking for vertical curves of LHS & RHS of Nagrota Bypass 9.000 km to 19.350 km.

Chainage	Type of curve	Design speed (v)	Gradient In (n ₁)	Gradient Out (n ₂)	Grade Difference N= (n ₁ +n ₂)	Curve Length (Given)	Curve Length (cal.)	Curve Length (Diff.)
LHS								
9.66	V	65	-0.2	0.6	0.38	40	40	0.00
9.78	S	65	-1.3	0.2	-1.03	80	40	40.00
10.05	V	65	-1.0	3.7	2.65	200	50	150.00
10.487	S	65	-2.5	-1.0	-3.58	175	68	107.00
10.94	V	65	3.2	-0.7	2.47	80	45	35.00
11.1	S	65	-0.5	0.1	-0.37	80	40	40.00
11.94	S	65	-0.9	-2.3	-3.22	300	60	240.00
12.27	V	65	2.9	-1.1	1.78	100	40	60.00
12.65	V	65	-1.1	2.9	1.86	100	40	60.00

12.97	V	65	-2.9	1.0	-1.92	300	40	260.00
13.485	V	65	-0.2	0.5	0.33	120	40	80.00
14.05	S	65	-0.7	-0.4	-1.08	120	40	80.00
14.585	V	65	-0.3	2.9	2.54	120	50	70.00
15	S	65	-2.0	-1.3	-3.24	250	60	190.00
15.25	V	65	1.4	0.3	1.78	100	100	0.00
16.185	V	65	-0.5	4.1	3.59	150	65	85.00

16.395	S	65	-2.9	2.9	0.01	150	40	110.00
17.72	S	65	0.1	-2.2	-2.12	180	40	140.00
18.07	S	65	3.8	-4.1	-0.32	60	40	20.00
18.47	V	65	1.4	-1.3	0.10	105	40	65.00
18.7	V	65	-0.3	1.3	0.97	70	40	30.00
18.91	S	65	-4.5	1.2	-3.32	60	64	-4.00
19.162	V	65	-1.7	1.4	-0.31	120	46	74.00
19.46	S	65	-3.4	0.9	-2.49	80	46	34.00
RHS								
9.663	V	65	-0.7	2.6	1.95	45	40	5.00
9.27	S	65	-3.6	1.1	-2.48	80	47	33.00
10.04	V	65	-0.9	3.6	2.72	200	50	150.00
10.487	S	65	-2.5	-1.1	-3.60	175	68	107.00

10.94	V	65	2.2	-2.2	0.08	80	40	40.00
11.1	S	65	-0.6	0.1	-0.46	80	40	40.00
11.273	V	65	-0.6	1.5	0.92	225	40	185.00
11.92	S	65	-1.1	-2.0	-3.03	300	56	244.00
12.27	V	65	2.9	-1.0	1.90	100	40	60.00

12.65	V	65	-1.0	2.9	1.83	100	40	60.00
13.485	V	65	-0.4	0.8	0.41	50	40	10.00
14.05	S	65	-0.9	-0.3	-1.19	100	40	60.00
14.58	V	65	-0.2	2.4	2.19	120	40	80.00
15.005	S	65	-1.8	-0.9	-2.73	250	51	199.00
15.25	V	65	2.2	-0.3	1.87	100	40	60.00
16.175	V	65	-1.0	0.5	-0.48	150	40	110.00
16.405	S	65	-3.4	1.8	-1.57	150	40	110.00

17.71	S	65	0.1	-2.3	-2.19	180	40	140.00
18.07	S	65	3.8	-4.1	-0.35	60	40	20.00
18.452	V	65	3.6	-1.3	2.27	105	40	65.00
18.735	V	65	-0.7	0.8	0.09	70	40	30.00
18.09	S	65	-1.5	0.9	-0.61	60	40	20.00
19.02	V	65	-0.6	0.2	-0.40	80	40	40.00
19.442	S	65	-3.4	1.1	-2.33	85	43	42.00

Table A.9 Data checking for vertical curves of LHS of Udhampur Bypass 0.000 km to 16.350 km.

Chainage	Type of curve	Design speed (v)	Gradient In (n ₁)	Gradient Out (n ₂)	Grade Difference N= (n ₁ +n ₂)	Curve Length (Given)	Curve Length (cal.)	Curve Length (Diff.)
2.432	S	65	3.1	-4.2	-1.09	125	40	85
2.745	V	65	3.3	-1.1	2.18	110	40	70
2.931	S	65	3.9	-3.2	0.69	140	40	100

3.02	V	65	-1.0	2.4	1.42	100	40	60
3.15	S	65	-4.5	4.2	-0.20	60	40	20
3.43	S	65	-3.8	3.0	-0.76	60	40	20
3.592	V	65	-3.2	3.1	-0.13	32	40	-8
3.91	S	65	0.4	0.3	0.61	61	40	21

4.23	S	65	1.8	-3.4	-1.56	100	40	60
4.43	S	65	3.3	-5.2	-1.90	60	40	20
4.605	V	65	4.1	-2.4	1.65	110	40	70
4.89	S	65	5.3	-0.7	4.62	60	86	-26
5.13	S	65	5.8	-2.2	3.63	60	67	-7
5.35	V	65	3.6	-0.9	2.70	180	50	130
6	V	65	-2.0	3.6	1.56	200	40	160
6.545	S	65	-4.3	1.2	-3.06	210	57	153
7.29	V	65	-0.3	1.1	0.83	60	40	20
7.815	V	65	-2.3	3.5	1.25	110	40	70
8.097	S	65	-3.0	-0.8	-3.81	275	71	204
8.51	V	65	2.5	-2.4	0.12	60	40	20

9.64	S	65	-3.4	-0.2	-3.68	200	68	132
9.995	v	65	1.4	-0.2	1.19	150	40	110
10.005	v	65	1.2	-0.2	0.98	160	40	120
10.79	v	65	-0.7	1.8	1.08	60	40	20
11.485	s	65	-0.8	-3.0	-3.77	350	70	280
11.775	v	65	3.4	-1.2	2.22	130	41	89
11.945	v	65	-0.2	1.8	1.57	50	40	10
12.155	s	65	-1.4	-0.4	-1.83	150	40	110
12.31	s	65	1.6	-1.9	-0.36	60	40	20
12.435	v	65	2.3	-0.4	1.85	70	40	30
12.65	v	65	-0.3	-0.3	-0.57	60	40	20
13.04	s	65	-0.9	-1.0	-1.90	300	40	260

13.36	v	65	1.8	0.7	2.55	120	48	72
13.52	v	65	-1.0	3.5	2.44	100	45	55
13.78	s	65	-3.8	1.7	-2.08	160	40	120
14.245	v	65	-0.9	1.5	0.63	100	40	60
14.86	V	65	-4.5	5.5	0.96	60	40	20
14.29	V	65	-0.6	0.4	-0.16	100	40	60

14.68	V	65	-3.8	3.7	-0.06	160	40	120
15.07	S	65	-3.6	1.4	-2.14	60	40	20
15.21	S	65	-3.6	1.4	-2.14	60	40	20
15.33	V	65	-1.4	3.9	2.43	60	48	12
15.85	S	65	-5.3	5.0	-0.32	60	40	20
16.2	S	65	-7.8	4.5	-3.33	60	62	-2

Table A.10 Data checking for vertical curves of RHS of Udhampur Bypass 0.000km to 16.350km.

Chainage	Type of curve	Design speed (v)	Gradient In (n ₁)	Gradient Out (n ₂)	Grade Difference N= (n ₁ +n ₂)	Curve Length (Given)	Curve Length (cal.)	Curve Length (Diff.)
RHS								
2.06	s	65	0.1	-1.3	-1.19	70	40	30.00

2.275	s	65	0.6	-5.0	-4.44	60	82	-22.00
2.412	s	65	3.6	-4.8	-1.14	115	40	75.00
2.842	v	65	1.5	-2.8	-1.32	105	40	65.00
2.99	v	65	-0.5	1.1	0.59	60	40	20
3.23	s	65	-3.2	-0.9	-4.10	80	40	40
3.42	s	65	3.1	-1.7	1.42	92	40	52
3.61	v	65	0.6	2.8	3.42	40	40	0
3.915	s	65	-7.2	2.8	-4.36	350	54	296

4.251	s	65	-3.5	-0.3	-3.81	103	40	63
4.47	s	65	1.9	0.3	2.18	60	40	20
4.67	v	65	-0.5	1.1	0.59	90	40	50
4.91	s	65	-3.2	-0.9	-4.10	60	40	20

5.15	v	65	3.1	-1.7	1.42	60	40	20
5.553	s	65	0.6	2.8	3.42	166	40	126
5.845	v	65	-7.2	2.8	-4.36	210	46	164

6.59	s	65	-3.5	-0.3	-3.81	215	44	171
7.31	v	65	1.9	0.3	2.18	60	40	20
8.112	s	65	-0.5	1.1	0.59	285	76	209
8.53	v	65	-3.2	-0.9	-4.10	60	40	20
8.87	v	65	3.1	-1.7	1.42	200	63	137
9.13	v	65	0.6	2.8	3.42	100	81	19
9.64	s	65	-7.2	2.8	-4.36	200	71	129
10.005	v	65	-3.5	-0.3	-3.81	160	41	119
11.48	s	65	-1.1	-2.3	-3.33	300	62	238.00
11.86	v	65	3.3	-0.5	2.76	40	51	-11.00
11.94	s	65	-1.0	-1.7	-2.70	60	50	10.00
12.175	s	65	-2.8	0.2	-2.52	150	47	103.00
12.435	s	65	1.3	-4.3	-2.99	90	56	34.00
12.53	v	65	0.3	-3.3	-3.06	70	57	13.00
12.7	v	65	-0.8	1.9	1.16	60	40	20.00
13.16	s	65	-1.2	-1.1	-2.35	300	44	256.00
13.42	v	65	2.5	-0.6	1.85	120	40	80.00
13.58	v	65	-1.3	3.4	2.14	100	40	60.00

13.315	v	65	-2.1	2.2	0.12	160	40	120.00
14.67	v	65	-4.5	5.4	0.84	100	40	60.00
15.07	s	65	-5.5	5.1	-0.43	60	40	20.00
15.27	S	65	-3.7	1.5	-2.15	60	40	20.00

15.37	V	65	-1.7	3.6	1.93	60	40	20.00
15.89	S	65	-5.2	4.8	-0.34	60	40	20.00
16.27	S	65	-3.9	2.4	-1.41	60	40	20.00

ACCIDENT DATA

Accident Summery of February

JAMMU UDHAMPUR HIGHWAY LIMITED																	
SUMMARY OF ACCIDENT/INCIDENT																	
		Month of 01.02.2016 to 29.02.2016															
			A	B	C	D	E	F	G	H							
S.No	Date	Time of Acc(am/pm)	Accident Location	Nature Of Accident	Classification Of Accident	Causes	Road Feature	Road Condition	Intersection Type & Control	Weather Condition	Vehicle Responsible	No. Of Affected Persons			No. Of Animals Killed (If Any)	Help Provided by Ambulance / Patrol Vehicle	Remarks
												Fatal	Grevious	Minor			
1	02-Feb-16	3:00 PM	28+400 RHS MR	Head on Collision	Minor	Fault of Driver	Four Lane	Flat Road	No intersection	Normal	Truck No.JK02BE-1579 Bus No.JK02AX-8095	-	7	-		Amb. No. 1 & Amb. No. 2 Crane No. 1	
2	04-Feb-16	12:30 AM	22+640 LHS NBP	Skidding	Minor	Over Speeding	Four Lane	Flat Road	No intersection	Normal	Motorcycle No. A/F	-	3	-		Amb. No. 1	
3	15-Feb-16	1:00 PM	29+100 LHS NBP	Overturning	Minor	Defect in mechanical condition of motor	Four Lane	Flat Road	No intersection	Normal	Car No.JKAA-7029	-	4	-		Amb. No. 1	
4	17-Feb-16	3:50 PM	26+500 RHS NBP	Skidding	Minor	Over Speeding	Four Lane	Flat Road	No intersection	Normal	Scooty No. JK02AK-5060	-	1	1		Amb. No. 1	

5	21-Feb-16	7:00 PM	48+870 LHS MR	Overtuning	Minor	Over Speeding	Four Lane	Flat Road	No intersection	Normal	Car No.JK02AW-7390	-	0	2		Amb. No. 3 Crane No. 2	
6	27-Feb-16	8:00 PM	B-24 RHS MR	Head on Collision	Minor	Fault of Driver	Four Lane	Flat Road	No intersection	Normal	Truck No .JK02BB-9406	-	4	-		Amb. No. 2 Crane No. 3	

Accident Summery of March

SUMMARY OF ACCIDENT/INCIDENT																	
		Month of 01.31.2016 to 31.03.2016															Page No.20
			A	B	C	D	E	F	G	H							
S.No	Date	Time of Acc(am/pm)	Accident Location	Nature Of Accident	Classification Of Accident	Causes	Road Feature	Road Condition	Intersection Type & Control	Weather Condition	Vehicle Responsible	No. Of Affected Persons			No. Of Animals Killed (If Any)	Help Provided by Ambulance / Patrol Vehicle	Remarks
												Fatal	Grevious	Minor			
1	2-Mar-16	3:40 PM	19+450 LHS NBP	Skidding	Minor	Drunken	Four Lane	Flat Road	No intersection	Normal	Car No. JK14-3337		3	2		Ambulance no 2	
2	3-Mar-16	2:10 PM	26+550 RHS MR	Skidding	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Motorcycle No. A/F		2			Ambulance no 1	
3	10-Mar-16	5:15 PM	30+450 LHS MR	Head on Collision	Minor	Overspeeding	Four Lane	Flat Road	T Junctionn	Normal	Bus No. JK20-2629		10	3		Ambulance No 1 & Ambulance No. 2	Bus Accident
4	10-Mar-16	5:20 AM	34+400 LHS MR	Overturning	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Car No. JK05C-7070			1		Ambulance No 3	
5	11-Mar-16	7:30 PM	11+160 RHS NBP	Head on Collision	Minor	Fault of driver of motor vehicle	Four Lane	Flat Road	No intersection	Normal	Car No. JK01H-1951		1			Ambulance no 2	

6	14-Mar-16	6:15 PM	15+080 LHS NBP	Skidding	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Motorcycle No. JK14B-0944		1	1		Ambulance no 2	
7	23-Mar-16	5:21 PM	19+070 RHS NBP	Right Turn Collision	Major	Fault of driver of motor vehicle	Four Lane	Flat Road	No intersection	Normal	Car No. JK02BL-2051 Tractor No.JK02AR-3316	1	2	3		Ambulance No 1 & Ambulance No. 2	
8	23-Mar-16	3:15 PM	18+500 LHS JBP	Rear End Collision	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	Car No. JK02BB-7616 Car No.JK02AF-6991		1			Ambulance no 2	
9	30-Mar-16	6:45 PM	22+640 TollPlaza	N/A	Minor	N/A	Four Lane	Flat Road	No intersection	Normal			1			Ambulance No 2	Patient shifted from breakdown Govt Ambulance

Accident Summery of April

SP JAMMU UDHAMPUR HIGHWAY LIMITED																	
SUMMARY OF ACCIDENT/INCIDENT																	
		Month of 01.4.2016 to 30.04.2016														Page No.20	
			A	B	C	D	E	F	G	H							
S.No	Date	Time of Acc(am/pm)	Accident Location	Nature Of Accident	Classification Of Accident	Causes	Road Feature	Road Condition	Intersection Type & Control	Weather Condition	Vehicle Responsible	No. Of Affected Persons			No. Of Animals Killed (If Any)	Help Provided by Ambulance / Patrol Vehicle	Remarks
												Fatal	Greivous	Minor			
1	6-Apr-16	1:05 PM	35+050 Main Road	Head on Collision	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	TRUCK NO JK02U-0377 MOTOR CYCLE JK14D -6688		1	0		Amb No 01	
2	9-Apr-16	9:18 PM	47+020 MR LHS	Overturning	Major	Overspeeding	Four Lane	Flat Road	T Junction	Normal	TEMPO No :- JK02AW-1149 TRUCK NO JK18 7064		4	2		Amb No 03	
3	13-Apr-16	12:10 PM	18+700 NBP	Head on Collision	Major	Drunken	Four Lane	Flat Road	No intersection	Normal	BUS NO JK14C-5353	1		2		Amb No. 01 Amb No. 02	
4	17-Apr-16	2:25 PM	22+640 LHS	Skidding	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	MOTOR CYCLE No. JK21-C3245		2			Amb No. 02	
5	20-Apr-16	6:00 AM	26+310 RHS	Overturning	Major	Overspeeding	Four Lane	Flat Road	No intersection	Normal	SCORPIO DLCNB-5958		4	4		Amb No. 01 Amb No. 02	Over Load

6	21-Apr-16	12:10 PM	B24	Overturning	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	BIKE WITH OUT NO		2	1		Amb No. 03	
7	29-04-16	6:45 PM	23+800 MR LHS	Head on Collision	Minor	Drunken	Four Lane	Flat Road	No intersection	Normal	SWIFT CARJK02AN8201		2			Amb No 01	
8	30-Apr-16	9:26 AM	13+020 RHS NBP	Head on Collision	Minor	Defect in mechanical condition of motor vehicle	Four Lane	Flat Road	No intersection	Normal	ALTO CAR JKO2X6435		2	1		Amb No. 03	
9	30-Apr-16	3:00 PM	B23 MEDAI N	Skidding	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	SCOOTY NO JKO2BG0496		2			Amb No 03	

Accident Summery of May

SP CEMENT (GUJARAT) PRIVATE LIMITED																	
SUMMARY OF ACCIDENT/INCIDENT																	
		Month of 01.5.2016 to 31.05.2016															Page No.20
			A	B	C	D	E	F	G	H							
S.No	Date	Time of Acc(am/pm)	Accident Location	Nature Of Accident	Classification Of Accident	Causes	Road Feature	Road Condition	Intersection Type & Control	Weather Condition	Vehicle Responsible	No. Of Affected Persons			No. Of Animals Killed (If Any)	Help Provided by Ambulance / Patrol Vehicle	Remarks
												Fatal	Greivious	Minor			
1	1-May-16	2:19 PM	15+560 RHS NBP	Overturning	Minor	Drunken	Four Lane	Flat Road	No intersection	Normal	CAR NO. JK14D-3339		2	1		Amb No. 01	
2	5-May-16	7:56 AM	13+480 RHS NBP	Overturning	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	CAR NO. PBO8CJ-8680		1	2		Amb No. 02 Crane No. 2	
	8-May-16	3:30 PM	18+300 RHS NBP	Skidding	Minor	Drunken	Four Lane	Flat Road	No intersection	Normal	BIKE NO. PB20E-2019		1	1		Amb No 01	
4	8-May-16	6:40 PM	17+860 RHS NBP	Right Turn Collision	Minor	Defect in mechanical condition of	Four Lane	Flat Road	No intersection	Normal	WINGER NO. JKO2AK-9474		2			Amb No. 02 Crane No. 1	

						motor vehicle					Car No. JKO2BP- 1059						
5	10- May-16	4:25 PM	19+220 LHS NBP	Skidding	Minor	Overspeedi ng	Four Lane	Flat Road	No intersectio n	Normal	BIKE NO. JK02K-5283		1	1		Amb No 02	
6	15- May-16	6:43 PM	18+920 RHS NBP	Skidding	Minor	Overspeedi ng	Four Lane	Flat Road	No intersectio n	Normal	BIKE NO. JK14-4268		1	1		Amb No 01	
7	16- May-16	6:00 PM	17+560LHS NBP	Overturni ng	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersectio n	Normal	TRUCK NO. JKO2AD- 1757		1			Amb No 01 Crane No. 2	
8	17- May-16	10:24 PM	18+720 RHS NBP	Rear End Collision	Minor	Overspeedi ng	Four Lane	Flat Road	No intersectio n	Normal	BIKE NO. JK02B-2617		1			Amb No 03	Hit By unknown vehicle
9	27- May-16	6:25 PM	48+-300 LHS MR	Overturni ng	Minor	Overspeedi ng	Four Lane	Flat Road	No intersectio n	Normal	CAR NO. JKO4C-0644		1	1		Amb No 01	
10	20- May-16	1:14 AM	29+800 RHS MR	Overturni ng	Minor	Vehicle out of Control	Four Lane	Flat Road	T Junction	Normal	CAR NO. JK02AT-4773		2	1		Amb No 03	
11	21- May-16	6:00 AM	20+640 LHS MR	Overturni ng	Minor	Overspeedi ng	Four Lane	Flat Road	No intersectio n	Normal	TAVERA NO. JKO2BE – 0454		1			Amb No 02 Crane No. 1	
12	26- May-16	7:23 AM	17+080 RHS NBP	Head on Collision	Minor	Fault of driver of driver	Four Lane	Flat Road	No intersectio n	Normal	WINGER NO. JK19- 3339		1	2		Amb No 01 Crane No. 2	

13	28- May-16	7:28 AM	13+200 LHS NBP		Minor		Four Lane	Flat Road	T Junction	Normal	UNKNOWN PERSON LYING ON ROAD IN UNCONCIO US CONDITION		1				Amb No 01	LYING ON ROAD IN UNCONCIOUS CONDITION
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Accident Summery of August

SHAPOORJI PALLONJI CEMENT (GUJARAT) PRIVATE LIMITED																	
SUMMARY OF ACCIDENT/INCIDENT																	
		Month of 01.08.2016 to 31.08.2016														Page No.20	
			A	B	C	D	E	F	G	H							
S.No	Date	Time of Acc(am/pm)	Accident Location	Nature Of Accident	Classification Of Accident	Causes	Road Feature	Road Condition	Intersection Type & Control	Weather Condition	Vehicle Responsible	No. Of Affected Persons			No. Of Animals Killed (If Any)	Help Provided by Ambulance / Patrol Vehicle	Remarks
												Fatal	Grevious	Minor			
1	19-Aug-16	10:00 AM	28+000 RHS MR	Skidding	Minor	Driver Drunk	Four Lane	Flat Road	No intersection	Normal	Motor cycle No. A/F		1			AMB NO 1	
2	24-Aug-16	6:45 PM	30+450 LHS MR	Skidding	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Motor cycle No. JK14-8757		1	1		AMB NO 1	
3	2-Aug-16	10:53 AM	21+500 RHS MR	Head on Collision	Minor	Vehicle out of Control	Four Lane	Flat Road	Y-Junction	Normal	Bus No. JK02F-2289 Auto No. JMUJ-1015		1			AMB NO 2	
4	5-Aug-16	2:45 PM	18+500 RHS JBP	Head on Collision	Minor	Overspeeding	Four Lane	Flat Road	T-Junction	Normal	Car No. JK02AA-8657 Bus No. JK20-3743		1	1		AMB NO 2	

5	5-Aug-16	9:10 PM	20+290 RHS NBP	Skidding	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	Scooty No. JKO2AB- 4213		1			AMB NO 2	
6	9-Aug-16	11:49 AM	10+500 RHS NBP	Skidding	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Motor cycle No. HR99- 9764		1			AMB NO 2	
7	9-Aug-16	3:18 AM	18+760 LHS NBP	Overturning	Major	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	Truck Trailer No. HR55S- 4328	1	2	2		AMB NO 2	
8	17-Aug-16	2:45 AM	21+800 RHS MR	Overturning	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Tata Mobile No. JKO5C- 5989		1			AMB NO 2	
9	21-Aug-16	3:10 PM	Nagrota Old Road	Rear End Collision	Major	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	Bus No. JK14C-8574 Motor Cycle No. JK14B- 2568	1	1			AMB NO 2	
10	22-Aug-16	10:56 AM	15+560 RHS NBP	Overturning	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Truck No. JK14B-1308		1			AMB NO 2	
11	22-Aug-16	7:30 PM	17+500 LHS NBP	Head on Collision	Minor	Defect in mechanical condition of motor vehicle	Four Lane	Flat Road	No intersection	Normal	Car No. JKO2V-7478 Truck No. JK03-2547		1	1		AMB NO 2	
12	23-Aug-16	12:27 PM	22+700 RHS MR	Rear End Collision	Minor	Defect in mechanical condition of motor vehicle	Four Lane	Flat Road	No intersection	Normal	Bus No. JK02E-8539		1			AMB NO 2	
13	8-Aug-16	5:48 PM	46+730 RHS MR	Skidding	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	Motor cycle No. JK02B- 1072		1			AMB NO 3	
14	29-Aug-16	10:00 AM	30+300 LHS MR	Overturning	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Motor cycle No. W/No. Car No. JK21- 0555		1			AMB NO 1	

15	29-Aug-16	4:00 PM	T4 LHS MR	Skidding	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Car No. JKO2AH-1092		1	2		AMB NO 1	
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Accident Summery of September

SHAPOORJI PALLONJI CEMENT (GUJARAT) PRIVATE LIMITED																	
SUMMARY OF ACCIDENT/INCIDENT																	
Month of 01.09.2016 to 30.09.2016																	Page No.20
			A	B	C	D	E	F	G	H							
S.No	Date	Time of Acc(am/pm)	Accident Location	Nature Of Accident	Classification Of Accident	Causes	Road Feature	Road Condition	Intersection Type & Control	Weather Condition	Vehicle Responsible	No. Of Affected Persons			No. Of Animals Killed (If Any)	Help Provided by Ambulance / Patrol Vehicle	Remarks
												Fatal	Grievous	Minor			
1	3-Sep-16	8:46 PM	29+200 RHS MR	Overturning	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	TATA SUMO NO. A/F		4	4		AMB NO 1	
2	20-Sep-16	9:30 PM	46+000 LHS MR	Skidding	Minor	Driver Drunk	Four Lane	Flat Road	No intersection	Normal	CAR No. JKO2R-6194		1	1		AMB NO 1	

3	24-Sep-16	8:00 PM	48+800 RHS MR	Overturnin g	Minor	Overspeedin g	Four Lane	Flat Road	No intersection	Normal	CAR No. JK14A-6553		1				AMB NO 1 CRANE NO. 2	
4	2-Sep-16	11:27 PM	13+840 RHS NBP	Skidding	Minor	Overspeedin g	Four Lane	Flat Road	No intersection	Normal	MOTORCYCL E No. JKO2BM-4219		1				AMB NO 2	
5	8-Sep-16	9:56 PM	19+460 RHS NBP	Skidding	Major	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	MOTORCYCL E No. JKO2BM1693	1					AMB NO 2	
6	9-Sep-16	07:56	18+400 LHS NBP	Head on Collision	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	HIT AND RUN		1				AMB NO 2	
7	10-Sep-16	7:05 PM	17+500 LHS NBP	Overturnin g	Minor	Overspeedin g	Four Lane	Flat Road	No intersection	Normal	MOTORCYCL E No. JK11A- 6836		1				AMB NO 2	
8	15-Sep-16	9:15 PM	18+650 RHS JBP	Overturnin g	Minor	Overspeedin g	Four Lane	Flat Road	Major Junction	Normal	MOTORCYCL E No. JK02AT- 8809		1	1			AMB NO 2	
9	16-Sep-16	8:23 PM	10+230 RHS NBP	Skidding	Minor	Overspeedin g	Four Lane	Flat Road	No intersection	Normal	MOTORCYCL E No. A/F		1				AMB NO 2	
10	17-Sep-16	9:30 PM	12+770 RHS NBP	Skidding	Major	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	MOTORCYCL E No. JKO2AP-2780	1	1				AMB NO 2	
11	17-Sep-16	4:45 AM	18+480 LHS NBP	Skidding	Minor	Overspeedin g	Four Lane	Flat Road	No intersection	Normal	SCOOTY NO. JKO2AL-6800		1	1			AMB NO 2	

12	20-Sep-16	7:15 AM	22+640 RHS MR										1				AMB NO 2	Patient received from breakdown ambulance
13	23-Sep-16	7:09 AM	18+650 LHS NBP	Skidding	Minor	Driver Drunk	Four Lane	Flat Road	No intersection	Normal	MOTORCYCL E No. PBO9W- 3177		1				AMB NO 2	
14	25-Sep-16	6:05 AM	T1 RHS MR	Skidding	Minor	Overspeedin g	Four Lane	Flat Road	No intersection	Normal	MOTORCYCL E No. JKO2BD-6145		1	1			AMB NO 2	
15	13-Sep-16	9:34 PM	T4 MR	Cardiac arrest		Cardiac arrest							1				AMB NO 3	Guard on Duty
16	15-Sep-16	3:21 PM	32+040 RHS MR	Overturnin g	Minor	Overspeedin g	Four Lane	Flat Road	No intersection	Normal	CAR NO. JKO3E-5130			2			AMB NO 3 CRANE NO. 1	
17	17-Sep-16	9:30 AM	12+710 RHS NBP	Skidding	Major	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	MOTORCYCL E No. JKO2AP-2780	1					AMB NO 3	

Accident Summery of October

SP JAMMU UDHAMPUR HIGHWAY LIMITED																	
SUMMARY OF ACCIDENT/INCIDENT																	
		Month of 01.10.2016 to 31.10.2016															Page No.20
			A	B	C	D	E	F	G	H							
S.No	Date	Time of Acc(am/pm)	Accident Location	Nature Of Accident	Classification Of Accident	Causes	Road Feature	Road Condition	Intersection Type & Control	Weather Condition	Vehicle Responsible	No. Of Affected Persons			No. Of Animals Killed (If Any)	Help Provided by Ambulance / Patrol Vehicle	Remarks
												Fatal	Grievous	Minor			
1	4-Oct-16	10:40 AM	22+800 LHS	Skidding	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Scooty No. JK02BK-1311		1	0		AMB NO 2	
2	5-Oct-16	10:40 AM	14+500 LHS NBP	Skidding	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Motorcycle No. A/F		1	1		AMB NO 2	
3	5-Oct-16	4:43 PM	20+300 LHS JBP	Skidding	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	Scooty No. A/F		0	2		AMB NO 2	
4	10-Oct-16	12:40 PM	32+540 LHS MR	Head on Collision	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	Car no. JK19-3716		1			AMB NO 2	

5	10-Oct-16	12:00 PM	29+100 LHS MR	Skidding	Minor	Overspeedin g	Four Lane	Flat Road	No intersection	Normal	Scooty No. JK02BQ- 8508		1	1		AMB NO 2	
6	10-Oct-16	12:00 PM	B21 RHS	Overturnin g	Minor	Overspeedin g	Four Lane	Flat Road	No intersection	Normal	Car No. JK02AC- 0321		1	1		AMB NO 1	
7	13-Oct-16	9:15 PM	V3 RHS MR	Head on Collision	Minor	Overspeedin g	Four Lane	Flat Road	Major Junction	Normal	Motorcycle No. JK14C- 7735		2			AMB NO 2	Hit Buffalo
8	26-Oct-16	4:45 PM	Toll Plaza	Head on Collision	Major	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	Truck No. TV52F- 4325 Car No. PB01 -1592		2	2		AMB NO 3 CRANE NO.2	
9	26-Oct-16	9:25 PM	Old Nagrota National Highwa y	Skidding	Major	Vehicle out of Control	Two Lane	Flat Road	No intersection	Normal	Car No. JK02BC- 1941	3	1			AMB NO 2 AMB NO 3 CRANE NO. 3	
10	26-Oct-16	11:15 PM	111+870 RHS NBP	Hit and Run	Major	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	Car No. JK02AB- 2212	1		1		AMB NO 3	
11	30-Oct-16	4:30 PM	15+300 LHS NBP	Hit and Run	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	Car No. JK02AX- 6821		1	1		AMB NO 2	
12	30-Oct-16	4:50 PM	B22 LHS	Skidding	Minor	Overspeedin g	Four Lane	Flat Road	No intersection	Normal	Motorcycle No. A/F		1	1		AMB NO 1	

Accident Summery of November

SUMMARY OF ACCIDENT/INCIDENT																	
	Month of 01.11.2016 to 30.11.2016																
			A	B	C	D	E	F	G	H							
S.No	Date	Time of Acc(am/pm)	Accident Location	Nature Of Accident	Classification Of Accident	Causes	Road Feature	Road Condition	Intersection Type & Control	Weather Condition	Vehicle Responsible	No. Of Affected Persons			No. Of Animals Killed (If Any)	Help Provided by Ambulance / Patrol Vehicle	Remarks
												Fatal	Grevious	Minor			
1	8-Nov-16	7:55 PM	43+100 MR RHS	Overturning	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	CAR NO. JKO2H-8616		1			AMB NO 1	
2	13-Nov-16	1:00 PM	B23 RHS	Skidding	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	MOTORCYCLE NO. JKO2R- 9327		1			AMB NO 1	
3	15-Nov-16	11:30 AM	B23 RHS	Skidding	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	SCOOTY WITHOUT NO.		1			AMB NO 1	

4	1-Nov-16	6:58 PM	20+300 NBP LHS	Skidding	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	MOTORCYCLE NO. JKO2AQ- 0964		1	1		AMB NO 2	
5	3-Nov-16	12:30 PM	9+960 NBP RHS	Overtuning	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	TRUCK NO. JKO2BM-3275		1			AMB NO 2	
6	6-Nov-16	4:50 AM	12+270 NBP RHS	Overtuning	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	CAR NO. JKO1S-3333		2	1		AMB NO 2	
7	23-Nov-16	12:35 PM	48+650 MR RHS	Rear End Collision	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	MOTORCYCLE NO. JK20-8198 TRUCK NO. A/F		2			AMB NO 1	
8	26-Nov-16	1:30 PM	B23 RHS	Overtuning	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	CAR NO. JK06- 1235		1	1		AMB NO 1	
9	24-Nov-16	3:37 PM	15+570 NBP RHS	Head on collision	Major	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	MOTORCYCLE NO. A/F CAR NO. JKO2AV-2771	1	0			AMB NO 2	
10	25-Nov-16	3:57 PM	18+720 JBP RHS	Rear End Collision	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	AUTO NO. JK14A-7451 BUS NO. JKO2AH-5814		1	1		AMB NO 2 CRANE NO. 3	
11	24-Nov-16	9:30 PM	31+260 MR LHS	Overtuning	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	TRUCK JKO2BD 1070		1			AMB NO 3	
12	25-Nov-16	2:05 PM	29+890 MR RHS	Rear End Collision	Minor	Vehicle out of Control	Four Lane	Flat Road	No intersection	Normal	INNOVA NO. A/F		1			AMB NO 3	

											MOTORCYCLE NO. GJ6CH 4816						
13	26-Nov-16	2:56 PM	26+200 MR RHS	Overtuning	Minor	Overspeeding	Four Lane	Flat Road	No intersection	Normal	BUS NO. JKO2AS-1477		1			AMB NO 3 CRANE NO. 3	
14	30-Nov-16	11:10 AM	T1 MR LHS	Hit and Run	Major	Hit and Run	Four Lane	Tunnel	No intersection	Normal	UNKNOWN VECHICLE	1	0		1	AMB NO 3	MAN RIDING ON HORSE HIT BY UNKNOWN VEHICLE