ROAD SAFETY AUDIT ON NATIONAL HIGHWAY 40 FROM NANDYAL TO KURNOOL

A Project Report Submitted in Partial Fulfilment of the Requirement for the Degree of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

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CERTIFICATE

This is to certify that the Project Report entitled "ROAD SAFETY AUDIT ON NATIONAL HIGHWAY 40 FROM NANDYAL TO KURNOOL" submitted by

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Dedicated to my beloved parents, and teachers who have worked hard throughout my education.

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ABSTRACT

India has a road network of an estimated 3.3 million km, which carries nearly 65 percent of freight and 85 percent of passenger traffic. The road traffic is estimated to be growing at an annual rate of 7-10 percent, while the vehicle population is growing at a rate of 12 percent per year. A Road Safety Audit (RSA) qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users. The Road Safety Audit consists of safety principles to the design of a new or a rehabilitated road section, to prevent frequent occurrence of accidents or to reduce their severity. In this project we have taken a stretch on NH-40 from nandyal to kurnool. Road safety audit is carried with the help of field survey reports on road merger or diverger, road curves , truck or bus lay by , culverts ,institutions ,median ,road intersections. This study follows MANUAL ON ROAD SAFETY AUDIT (IRC:SP:88-2010). The scope of study is to identify the accident prone areas , minimize accidents on the road and need for costly remedial work is reduced

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Chapter 1

INTRODUCTION

1.1 General

In todays world road and transport has become an integral part of every human being. Everybody is a road user in one shape or the other. The present transport system has minimized the distances but it has on the other hand increased the life risk. Every year road crashes result in loss of lakhs of lives and serious injuries to corers of people. In India itself about eighty thousand people are killed in road crashes every year which is thirteen per cent of the total fatality all over the world. The accident is of three types due to their effects or seriousness, fatal accident, injury and property damage only. Man behind the wheel plays an important role in most of the crashes.in most of the cases occur either due to carelessness or due to lack of road safety awareness of the road user. Hence, road safety education is as essential as any other basic skills of survival.

Road traffic safety refers to methods and measures for reducing the risk of a person using the road network being killed or seriously injured. The users of a road include pedestrians, cyclist, motorists, their passengers, and passengers of on road public transport, mainly buses and trains. Best-practice road safety strategies focus upon the prevention of serious injury and death crashes in spite of human fallibility. Safe road design is now about providing a road environment which ensures vehicle speeds will be within the human tolerances for degree of safety shall be ensured when transporting goods by road. It is of vital importance to monitor and validate the road transportation safety, including comprehensive checks on drivers, vehicle and safety processes. Road safety is a complex issue and there are a high number of factors and indicators involved in the accidents. The problem itself is underestimated in many countries, especially in developing countries where the issue is challenging.

In India transportation is heavily dependent on the road network. In 1990s, India was among the top nations with raising economics due to urbanisation. It has influenced in the rise of traffic volume on road. National highways of India are only 2% of the total road network but carries about 40 percent of the total road traffic. It influenced in increase of the total worlds vehicles and road accidents. Through, India has only 1% of the total worlds vehicle which accounts for 16% of the total worlds accidents deathson road traffic accidents which are generally unintended and preventable are a common risk every day to life that can happen to almost every one, anywhere. The problem of road traffic accident is increasingly becoming a threat to public health and national development in many developing countries. Road traffic accident contributes to poverty by causing deaths, injuries, disabilities, grief, loss of productivity and material damage.

Statistical projection show that during the period between 2000 and 2020, fatalities related to traffic accidents will decrease with about 30%in high income countries. The opposite pattern is expected in developing countries, where traffic accidents are expected to increase at a fast rate in the years to come. A study done in Calcutta India, Reported that there are some host (human) factors (such as the behaviour of drivers, pedestrians and cyclist behaviours) and seasonal factors (weather and time) that contribute to fatal road traffic accidents . Overall, most traffic accident occurred on main roads (highways) and in the majority of cases pedestrians were found to be at fault during crossing the road .

1.2 Need of study

India has the second largest road network in the world with over 3 million km of roads in which 60% are paved. On the whole, the facilities for roads users are not up to the mark, leading to the high toll of the death victims. Road safety is emerging as a major social concern in the country in the country. The statistics are mind boggling with an average rate of 100,000 persons dying in road accidents.

According to the report, the number of road traffic deaths across the world was unacceptably high at 1.24 million per year and another 20 to 50 million sustain nonfatal injuries as a result of road traffic crashes. The report says that only 28 countries, representing 449 million people (7% of the worlds population), have adequate laws that address all five risk factors speed, driving under influence, helmets, seat belts and child restraints, India has poor record on all the above five fronts.

Following are some of the facts related to India:

1. 85% of all road accident deaths occur in developing countries and nearly half in the Asia-Pacific region.

2. India accounts for about10 percent of road accident fatalities.

3. An estimated 1,275,000 persons are grievously injured on the road every year. Social cost of annual accidents in India has been estimated at Rs.660000.

4. Professionalism in driver training is absent, proportion of untrained drivers is continually on the rise and a positive driving culture is lacking.

1.3 Objectives

Identify engineering defects and suggests interventions. Identify and recommend facilities that can be used to extend medical support to accident victimes quickly as possible. Identify and evaluate how technology can be used to reduce road accidents.

1.4 Scope of study

This study includes identification of the deficit of traffic signs/markings, geometrical deficit and other road accessories in the existing scenario of accident occurrence, and identify the need of speed regulation / alternate measures of traffic management to access the existing section with respect to the standard IRC/HCM. . Identification of the Black spot by using an accident data and prioritizing the hazardous zone for intervention

1.5 Summery

This chapter contains small introduction about study, need of study, objective of study and scope of the work.

Chapter 2

ACCIDENT SCENARIO

2.1 General

Road accidents are human tragedy, which involve high human suffering. They impose huge socio-economic cost in terms of untimely deaths, injuries and loss of potential income. The ramification of road accident can be colossal and its negative impact is felt not only on individuals, their health and welfare, but also on economy. Consequently, Road safety has become an issue of national concern.

Many of these traffic injuries and deaths take place in constructions zone on all roads and highways. In addition, a significant number of workers associated with construction and maintenance of roads also get injured and killed every year. This increasing trend in injuries and fatalities has been recognised as a public health problem of significance by the authorities and public at large. There is an urgent need to train practitioners and policymakers in the scientific approach to injury prevention. There needs to be a cadre of professionals working from a shared understanding of the magnitude of the problem of road traffic and work injuries, risk factor and the value of implementing evidence-based strategies.

This underscores the need for persons working at all levels in road construction and maintenance to be equipped with appropriate knowledge and skills derived from empirical evidence and professional wisdom. Intervention programmes seeking to prevent injuries need to address the problem of capacity in different sectors.

2.2 Global accident scenario

Road traffic injuries are the eight leading cause of death globally, and the leading cause of death for young people aged 15-29. More than an million people die each year on the worlds roads, and the cost of dealing with the consequences of these road traffic crashes runs to billions of dollars. Current trends suggest that by 2030 road traffic deaths will become the fifth leading cause of death unless urgent action is taken. According to the World Health Organization has not increased- but remains unacceptably high at 1.2 million per year, down from 1.26 million in 2000. Half of all road traffic deaths are among pedestrians, cyclists and motorcyclist, and adults aged between 15 and 44 years account f 3 out of 4 road deaths are among men. The average rate was 18 per 100,000 people (down from 20.8 in 2000). 92

The overall global road traffic fatality rate is 18 per 1,00,000 population.However, middle-income countries have the highest annual road traffic injuries rates, at 20.1 per 100,000 while the rate in high income countries is lowest, at 8.7 per 100,000 eighty per cent of road traffic death occur in middle-income countries,which account for 72 percent of the worlds population, but only 52 percent of the worlds registered vehicles. This indicates that these countries bear a disproportionately high burden of road traffic deaths relative to their level of motorization.

However, this global analysis masks significant differences regarding who is most at risk by country income status and by WHO region. In most low countries, a much higher proportion of road users are pedestrians motorized two- or three- wheeled vehicles than in high income countries.

2.3 Accident scenario of India

Road Accidents, Registered Vehicles and Road Length in India (1970-2017)

Year	Road Accidents ('000)	Road Accident Deaths ('000)	Road Accident Injuries ('000)	Registered Vehicles ('000)	Road Length ('000 km)	Fatality rate (no. of accident deaths per 10,000 vehicles)	Vehicle density (no. of vehicles per km of road)
1970	114	15	70	1401	1,189	103.50	1.18
1980	153	24	109	4,521	1,492	53.09	3.03
1990	283	54	244	19,152	1,984	28.25	9.65
2000	391	79	399	48,857	3,316	16.15	14.73
2010	500	135	528	1,27,746	4,582	10.53	27.88
2015	501	146	500	2,10,023	5,472	6.96	38.38
2016	481	151	495	2,30,031	5,603	6.55	41.05
2017	465	148	471	NA	NA	-	-

Figure 2.1: Road Accidents, Registered Vehicles and Road Length in India (1970-2017)

Type of the accidents and accident severity in indian scenario.

Year	Number of Accidents		Number of Persons		Accident Severity*
	Total	Fatal	Killed	Injured	
2005	4,39,255	83,491 (19.0)	94,968	465282	21.6
2006	4,60,920	93,917 (20.4)	105,749	496,481	22.9
2007	4,79,216	1,01,161 (21.1)	114,444	513,340	23.9
2008	4,84,704	1,06,591 (22.0)	119,860	523,193	24.7
2009	4,86,384	1,10,993 (22.8)	125,660	515,458	25.8
2010	4,99,628	1,19,558 (23.9)	134,513	527,512	26.9
2011	4,97,686	1,21,618 (24.4)	1,42,485	5,11,394	28.6
2012	4,90,383	1,23,093 (25.1)	1,38,258	5,09,667	28.2
2013	4,86,476	1,22,589 (25.2)	1,37,572	4,94,893	28.3
2014	4,89,400	1,25,828 (25.7)	1,39,671	4,93,474	28.5
2015	5,01,423	1,31,726 (26.3)	1,46,133	5,00,279	29.1
2016	4,80,652	1,36,071 (28.3)	1,50,785	4,94,624	31.4
2017	4,64,910	1,34,796 (29.0)	1,47,913	4,70,975	31.8

Figure 2.2: Type of the accidents and accident severity in indian scenario

2.4 Accident scenario at state level(A.P)

Type of Road accidents in States/ UTs in 2017						
S.No	States/UTs	Fatal Accidents	Grievous Injury Accidents	Minor Injury Accidents	Non-Injury Accidents	Total Accidents
1	2	3	4	5	6	7
1	Andhra Pradesh	7,564	4,607	10,285	3,271	25,727

Total Number of Road Accidents on National Highways*: 2014 to 2017

Sl. No.	States/UTs	State/UT-Wise Total Number of Road Accidents on National Highways during			
		2014	2015	2016	2017
1	2	3	4	5	6
1	Andhra Pradesh	8799	8477	8171	8544

Figure 2.3: Accident scenario at state level(A.P)

2.5 Types of accidents

Accident is an unfortunate incident that happens unexpectedly and unintentionally, typically resulting in damage or injury or in other words, it is an event that happens by chance or that is without apparent or deliberate cause. There are mainly four type sof accidents based on the severity of it.

1. Fatal accidents
2. Major accidents
3. Minor injuries
4. Property damage only

2.6 Causes of accidents

The study of the various causes of accidents is very vital for Traffic safety and Traffic engineering both. Broadly the factor that causes accidents due to traffic element:

1. Improper Geometry
2. The vehicle
3. The Driver
4. The Road user other than Motorist
5. Environmental Factors
6. Skidding
7. Improper parking

2.6.1 Causes of Accident due to Improper Geometry

The characteristics of a road have a great influence on the causation of accident. Improvement to the conditions of the road can bring about a measurable change in the accident. The Highway engineer & the Traffic engineer has an important duty in ensuring that the roads are designed at proper standards, built to the correct specification and maintained adequately. It is being increasingly realized that safety can be built into the highways. The followings are the causes of accidents due to improper parameters.

1.Improper Vertical Alignment.
2.Inadequate sight Distance.
3.Improper super Elevation.
4.Insufficient width of Carriageway.
5.Improper Junction Design.
6.Deficiency in Road Signs & Road Marking.
7. Narrow Bridges & Culverts.

2.6.2 The Vehicle

It is being increasingly realized that vehicle play a dominant role in road safety. One estimate puts that mechanical deficiencies cause about 5 percent of all traffic accidents. The subject vehicle safety is controversial while on the one hand, the manufacturers maintain that the present day cars are safe, provide they are run and maintained with care, whereas on the other hand the consumers argue is that vehicles are the biggest culprits that cause serious accidents. The truth perhaps is that no vehicle is perfectly safe, and the researcher of vehicle design and maintenance are involved in making:

1. Accidents fewer in number.
2. Accidents less serious to other road user.
3. Accidents less severs to vehicle occupants.

Parameters of Vehicle for Occurrence of Accidents

Following parameters are mainly responsible for accidents:-

1. Breaking system
2. Lighting system
3. Age and maintenance of vehicles.
4. Vehicle body and its features.

Factors that need to be considered for vehicle body are:

1. The shape and dimensions of the drivers seat.
2. Arrangement of dials on the dashboard.
3. Positioning of controls in relation to the drivers seat.
4. Visibility of the driver from the seat.
5. Noise levels in the vehicle.
6. Concentration of carbon monoxide inside the vehicle.
7. Tyres.
8. Vehicle inspection and maintenance.

2.6.3 The driver

The following parameters of drivers are influencing in occurrence of accidents

1. Driver judgment, skill and emotional make up
2. Age of drivers.
3. Sex of the drivers.

4. Marital status.

5. Training of drivers.

2.6.4 Environment Factors

Unfavourable weather condition such as mist, fog, rain, dust, snow, etc. reduce visibility. People are more prone to accidents during night hours due to darkness and glare. Besides the above causes, increase in population and wealth, enabling more people a greater amount of individual travel and mans physical and emotional limitations to live safely in a mechanized environment are responsible for the growth in road accidents.

2.6.5 Skidding

Road accidents are very commonly caused by pavement slipperiness, which results I n skidding of the vehicle. Accident statics show that in U.K. 27 per cent of the accident involving vehicles was attributed to skidding. Considerable research efforts ha seen expended on the subject of pavement slipperiness and skidding in countries abroad, especially in U.S.A., U.K, and some countries in the continent. In India, not much attention seems to have been paid so far to this subject, though skidding can occur on our roads in the rainy season.

The phenomenon of skidding

When a driver moving at speed applies the vehicle rakes suddenly, the prime factor that governs the stability of the vehicle is the friction that develops at the tyre Pavement interface, If the friction that can be mobilized is greater than the decelerating force, the pavement is wet and slippery and the tired bald, the friction that is developed is much smaller than the decelerating force, and vehicle cannot be controlled by driver. The wheels of the vehicle get locked due to sudden braking and skidding result if the frictional resistance offered is too low.

Factors Affecting Skid Resistance

The following factors determine the skid resistance at the pavement interface:

1. Pavement
2. Effect of water on the surface

3. Speed

4. Tyre characteristics

2.6.6 Parking & Its Influence on Accidents

Parking of vehicle is one of the major contributors to accidents. Accidents can occur in the following ways:

1. Parking and un-parking manoeuvres can cause accidents to pedestrians, cyclists or to other motorists.

2. Opening of car doors on parking can suddenly cause a cyclist or a motorist to be involved in accidents.

3. Pedestrians can rather between parked vehicles or in front of a parked vehicle, unnoticed by a speeding vehicle.

2.7 Summary

In this chapter, the general overview about road safety and accidents scenario at world, national and state level are discussed. It also includes the types and causes of accidents.

Chapter 3

LITERATURE REVIEW

3.1 General

Review of literature is important in any research work. Many researchers have carried out research work in the area of road accidents and safety. Some of them have analysed accident data in different ways. Some of them have done Identification of Black spot zones. Some of them have worked on Road safety audit and proposed strategies for road safety. In the present chapter literature review is carried out covering the different issues related to the road safety.

3.2 Review of Research Papers

Some of the literature in which analysis of accident data has been carried out and suggestions for road safety is given is briefly discussed here. They found some conclusion due to their research work.

Parikh V. and Dr. Jain A.M. (2014) has carried out a Road Safety Audit: Development of an accident model for Urban area on Narol-Naroda National Highway of Ahmedabad city and developed an accident model for urban area. The paper is having a main two goals, first is to carry out a road safety audit on a selected corridor of urban area and second is to develop an accident model taking time of accident as a main parameter. To achieve both of the goal-Accident data, Classified Volume count survey, spot speed survey, Road Inventory Survey has been carried out and remedial measures are given for the corridor. The linear regression model

is developed, for that total accidents, fatal accidents, major accidents and minor accidents are considered as dependent variable and accidents per month respected to time is considered as independent variables. After conducting Road Safety Audit they have concluded that there is a deficiency in geometric design of corridor, absence of traffic police, not working traffic signal, unauthorized parking at intersection. Based on accident data majority of accidents occurred at the Narol circle, Isanpur, Ghodasae, C.T.M and Expressway cross road. There are no traffic signals provided at any those five intersections, no provision of service lane and parking lane from Ghodasar to Jasodanagar road. The heavy volume of auto is parked at narol circle, Insanpur intersection and expressway Tran Rasta, this reduction in the available road space for the through traffic congestion and ultimately leads to accidents at various critical locations. There is a need of tapering at entrance of service lane.

A. Shalon Hakkert and Victoria Gitelman (2014) has done survey on Thinking about the history of road safety research: Past achievements and future challenges in this they have done survey on the development in road safety thinking and road safety research over the last century. This paper is giving the details about general evolution of safety thinking as it applied to road user behaviour, vehicle and road design. From a historical consideration, a major change observed more recently both in road safety research and in road safety activities concerns the emphasis shift from segmented research focused on single areas such as the driver, the vehicle and the road, towards a systems view. Moreover examining various developments that have occurred over years regarding road user behaviour, vehicle design and infrastructure, a clos interrelation between road safety research abilities and road safety interventions applied can be observed. In terms of future research, a shift in modality towards more vulnerable road users and their needs, more attention to safety implications of denser cities, greater use of public transport, inter-modality and coordination between the spatial development and the transportation system, can be foreseen.

Joshua Reid Jones et. Al. (2013) presented the result of field data collection conducted by the Utah Local Technical Assistance Program (Utah LTAP) in conjunction with the Utah Department of Transportation. The first step of the research was data collection from 18 road safety audits conducted throughout the state of Utah. The purpose of this research was to provide quantification to the RSA process that would increase the benefits gained from implementing the RSA recommendations. Benefits derived from the implementation of RSA recommendations were found by assessing the change of risk from before and after safety im-

provements. The RSA quantification tool was developed to analyse projects in both urban and rural settings. The tool showed the different project alternatives. The quantification tool will be able to analyse the potential risk during the field observation and after the safety recommendations are made. This paper proposes a seven category decision making tool that can help quantify the potential risk observed on the roadway into a number that can be analysed. The result shows that all of the categories having potential risk reductions after the safety recommendations were made. The categories with the most reduction were centred on low cost safety improvements of maintenance and sign improvements. The tool will help decision makers in targeting areas of the roadway that showed high risk.

Mario De Luca et. Al. (2012) has proposed a procedure to identify these black spots. Four different road sections were selected in Southern Italy for the study. For each road section the accident data since 2004 to 2008 were collected. The good statistical fitting between the estimated parameters and those surveys confirms the validity of the models and, at the same time, their reliability to define road safety improvements. The procedure described has provided important clues to identify the Hazardous areas due to poor coordination of the track. The results have shown that the procedure also works on segment other than those on which has been obtained models (1) and (2). Developed model can be used to analyse more segments and to identify priority area of intervention

Thomas F. Golob et. Al. (2004) has developed a tool, called FITS (Flow Impacts on Traffic Safety) which can be used to assess the changes in traffic safety tendencies that result from changes in traffic flow. The tool use data from single inductive loop detectors, converting 30-second observation of volume and occupancy for multiple freeway lanes into flow regimes. Each regime has a specific pattern of crash types, which were determined through nonlinear multivariate of over 1,000 crashes on freeways in Southern California. This research may provide the foundation to forecast the crash rates, in terms of vehicle miles of travel, for vehicle that are exposed to different traffic flow conditions. Data covers that occurs in six major freeway routes in Orange county, California, during calendar year 1998 which were drawn from the Traffic Accident Surveillance and Analysis System (TASAS) database which covers all police-reported crashes on the California State Highways System. Other applications might be compare the same section of roadway during different time periods or under different weather/lighting condition. FITS applies only to urban freeways with at least three lanes in each directions but validation has not yet been conducted, so we cannot confirm the degree of

spatial transferability. FITS provides information as to which types of crashes are more likely under different types of traffic flow, but does not forecast crash rates.

3.3 Summary

In this chapter the literature related to Analysis of Accident Data, Identification of Black spot Area, and development of model to provide road safety are discussed.

Chapter 4

STUDY AREA AND METHODOLOGY

4.1 Study area

Growth of road transport is fast in NH-40 .NH-40 is one of the corridor where is heavy volume and many problems of traffic movement. A heavy vehicle and passengers are moving on the NH-40.The study is carried out on the cooridor of Nandyal to Kurnool Highway.The length of the study area is 19.7 km, carriage width of road is maximum 7m from Nandyal to Kurnool on both sides.

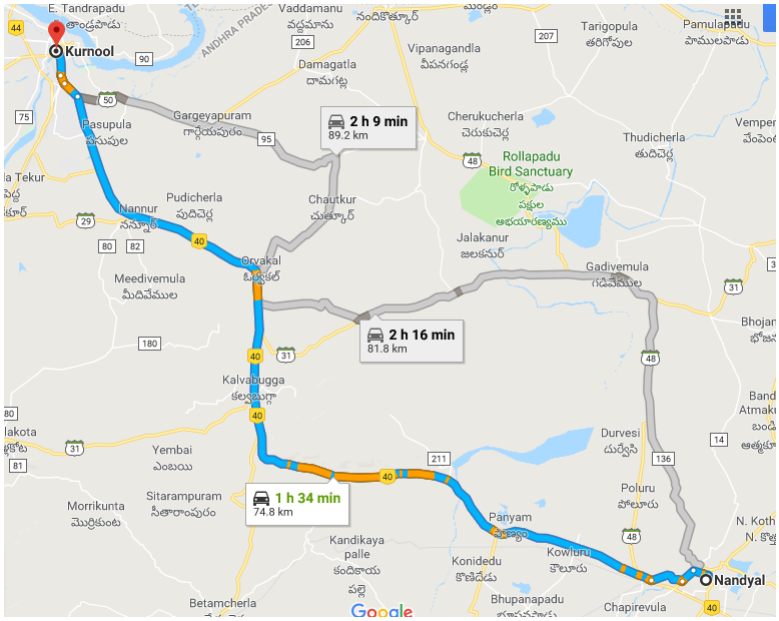

Figure 4.1: Study area from Nandyal to Kurnool on NH-40.

4.2 Methodology

The completion of any work needs planning before starting a work. The methodology of work is part of that planning phase and that is why it is necessary to develop methodology of work. It covers the whole work which is going to be carried out for the completion of thesis. The first step in methodology is to identify the problems; it covers the subject of work. The next is literature review, in this step the previous years works on that subject are collected and has been studied carefully. The third step is to select stud area for implementing thought of work and it should be suitable for the objective. After the selection of study area the work should be decided. For achieving that goal the data collection and data analysis is carried out. Once the data analysed, on the bases of analysis results some remedial measure for road safety is going to be suggested. Last step is to give conclusion of this work done. Complete flowchart of each activity showing various stages involved is shown in Fig.

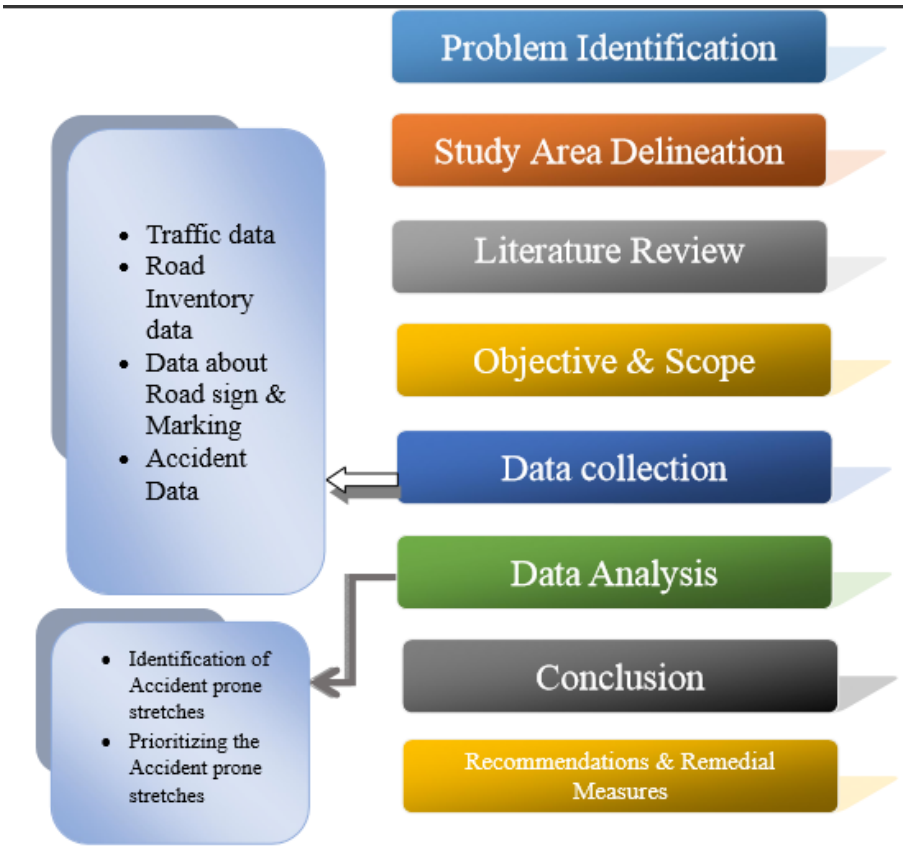

Figure 4.2: flowchart of each activity showing various stages involved

The following are the list of villages that passes through NH-40:

1 Chagalamarri

2 Madduru

3 Pedda Bodhanam

4 Allagadda

5 Peraipalle Mitta

6 Nallagatla

7 Bathaluru

8 Venkatapuram

9 Sirivella

10 Govindapalle

11 Deebaguntla

12 Nandyal

13 Venkateswarapuram

14 Balapanur

15 Panyam

16 Sugalimitta

17 Thammarajupalle

18 Somayajulapalle (Bethamcherla Cross)

19 Kalvabugga

20 Hussainapuram

21 Orvakal

22 Nannur

23 Vengannabavi‘

24 Kurnool

On NH-40., we have selected the stretch from Nandyal to Kurnool.

4.3 Summary

This chapter includes study area profile and methodology developed according to which the whole work is going to conduct.

Chapter 5

DATA COLLECTION

5.1 General

The accident situation in general is very serious and more worrisome in large cities which accounts for maximum number of accidents. In most of the cases crashes occurs either due to carelessness or due to lack of road safety awareness of the road users. For this purpose the road safety audit carried out on the stretch:"Nandyal to Kurnool". The data collected for the study are Classified Volume Count, Spot Speed, Road inventory and Highway crashes. An Accident data for the period 2012 to 2017 were obtained from different police stations on the study area.

5.2 Accident Study

5.2.1 Site visitings

From Nandyal to somayajula palli

December from 21/12/2018 to 23/12/2018

January from 4/01/2019 to 06/01/2019

February from 01/02/2019 to 03/02/2019

From somayajula palli to kurnool

Febraury from 22/02/2019 to 23/02/2019

March from 01/03/2019 and 2/03/2019

5.3 Accident data of study area

Year	Two wheelers	Auto rikshaw	Car\jeep	bus	Tempo\ trac5to r6	Light trucks	Heavy trucks	Bicycle	Cycle rickshaw	Total
2012	10	5	5	1	0	1	3	1	0	27
2013	4	6	6	2	0	4	5	1	0	24
2014	2	12	12	4	0	3	4	1	0	33
2015	11	7	7	1	1	2	2	1	0	30
2016	9	2	2	1	5	0	1	1	0	30
2017	5	4	4	3	1	1	2	0	0	21
Total	41	35	36	12	7	12	16	5	0	164

Figure 5.1: Accidents data of study area

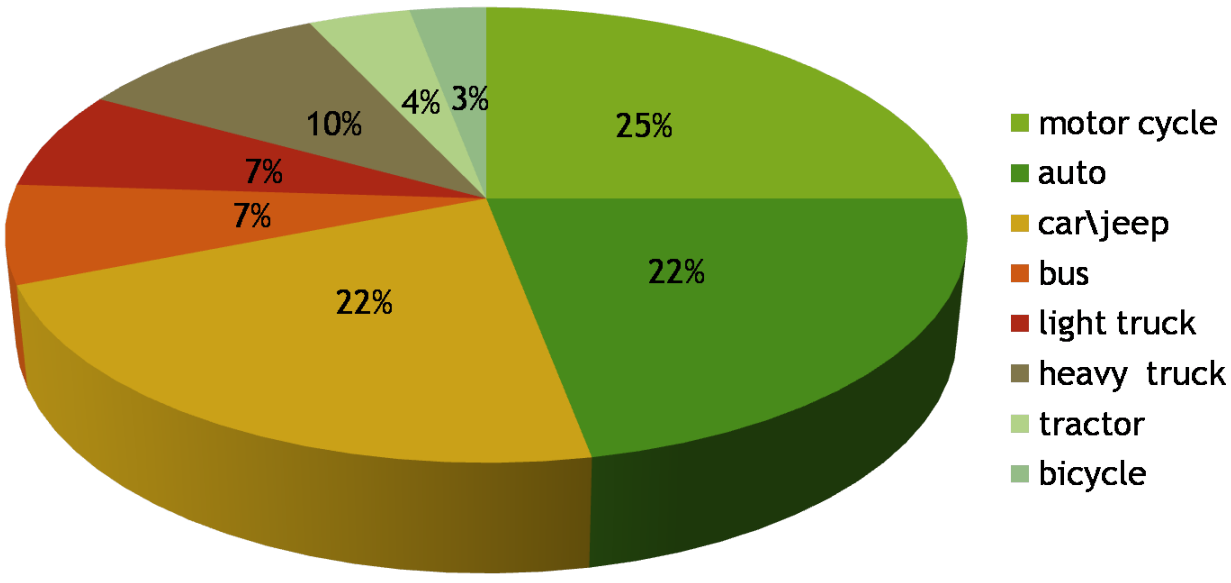

Figure 5.2: Accidents data of study area

Observation from the above pie is the major accidents is caused by Motorised Two Wheeler(25%) and the minor is caused by Bicycle(3%)

Year	fatal	Grivious injury	Minor injury	total
2012	6	8	22	36
2013	14	7	21	42
2014	12	12	15	39
2015	9	13	23	45
2016	5	21	25	51
2017	5	15	21	41
total	51	76	127	254

Figure 5.3: Type of accidents (Type vs Year table and barchart)

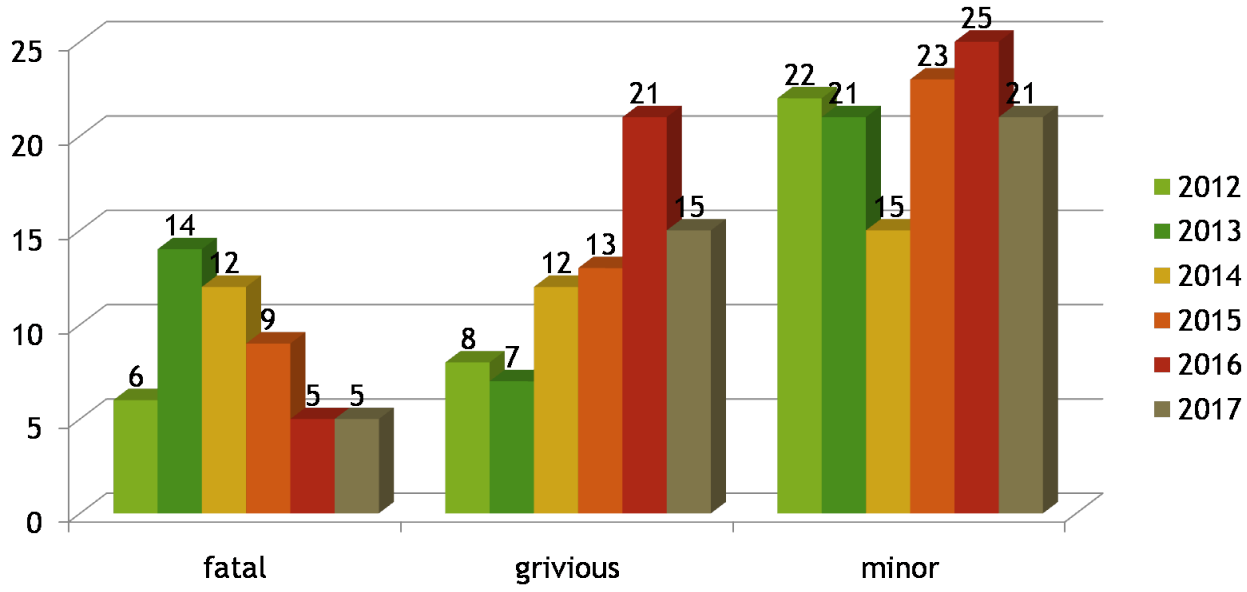

Figure 5.4: Type of accidents

Observations from above barchart are

1. Fatal accidents are major in the year of 2013 with14 accidents and minor in the year 2016 and 2017 with 5 accidents.

2.Grivious injury accidents are major in the year of 2016 with 21 accidents and minor in the year 2013 with 7 accidents.

3. Minor injury accidents are major in the year of 2016 with 25 accidents and minor in the year2014 with15 accidents.

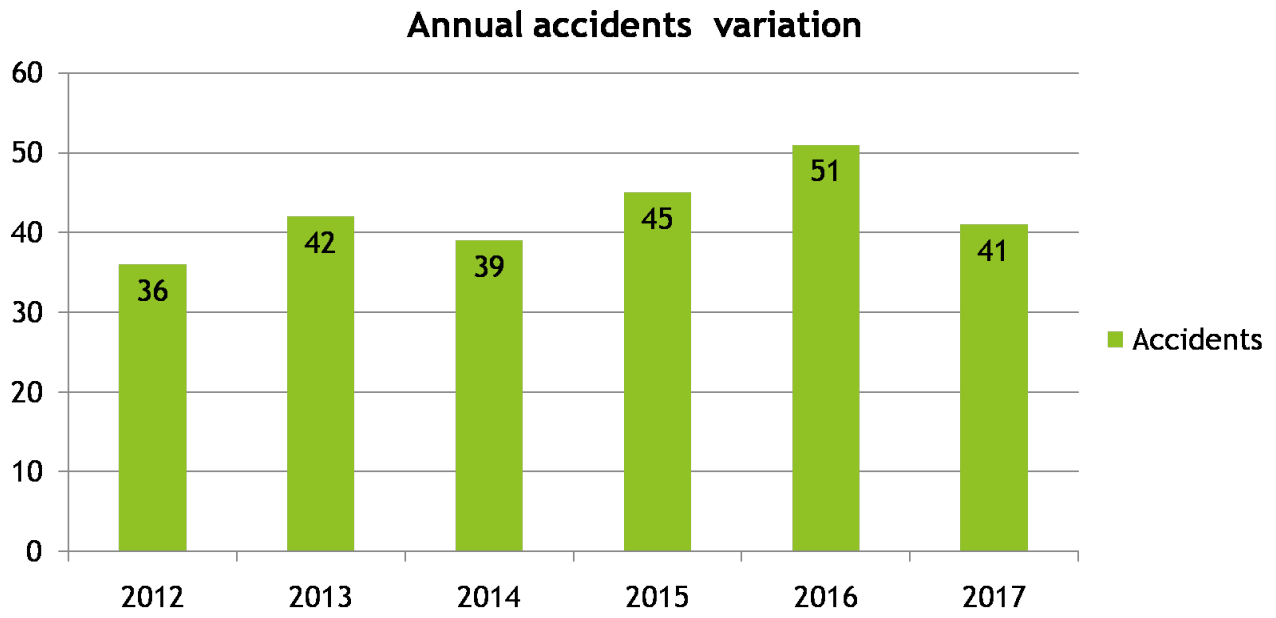

Figure 5.5: Annual variation of accidents

Observation from above bar chart are the annual variation in accidents is major in the year of 2016 with 51 accidents and minor in the year of 2012 with 36 accidents.

AGE GROUP	FATAL	GRIVIOUS INJURY	MINOR INJURY	TOTAL
10-14	0	0	0	0
15-19	4	2	6	12
20-24	6	6	9	21
25-29	9	10	29	48
30-34	12	25	27	64
35-39	9	14	25	48
40-44	6	7	17	30
45-49	5	9	10	24
50-54	0	3	2	5
55-59	0	0	1	1
60-64	0	0	1	1
65-69	0	0	0	0
Total	51	76	127	254

Figure 5.6: age variation

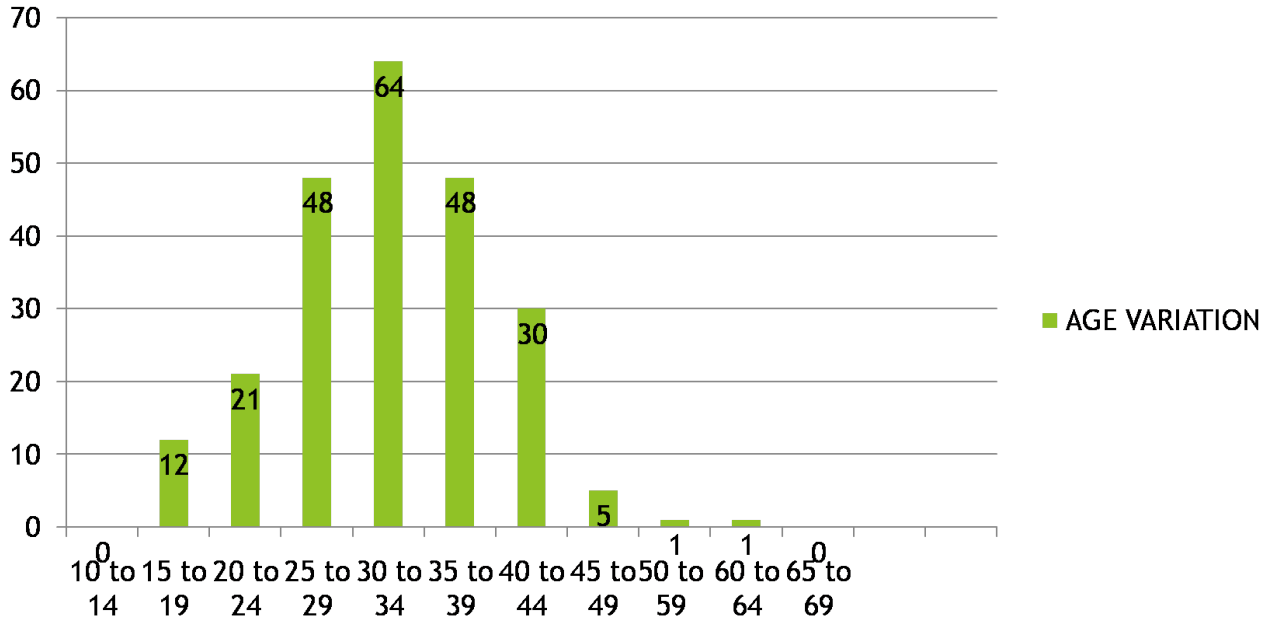

Figure 5.7: Bar chart for age variation

5.3.1 Teams involved in Road safety audit

1. Andhra Pradesh Transport Department
2. Andhra Pradesh Police Department
3. NHAI Officials of jurisdiction
4. RGM Engineering College , Nandya
5. SVR Engineering College, Nandyal
6. G Pulla Reddy Engineering College, Kurnool

5.4 Road Inventory Survey

Road inventory survey was carried out from Nandyala to Kurnool on NH-40.

Inventory Survey					
Sr	Location	Carriageway width in m	Median width in m	shoulder	
				Paved	Unpaved
1	NH-40 LCW	7	5	1.5	2
	NH-40 RCW	7	5	1.5	2

Figure 5.8: Road Inventory Survey

5.5 summary

In this chapter, Road accident statistics of Rajkot-Morbi Highway, Road Inventory survey, Classified Volume Count, Spot speed survey are discussed.

Chapter 6

ROAD SAFETY AUDIT

6.1 General

This chapter discusses broad findings of the audit that require attention for bringing down the accidents in this stretch of the road. Road safety Audit was conducted where in the length of the road was travelled and walked around where necessary. A few photographs were also taken depict the critical situations.

6.2 Objectives of Road Safety Audit

1.To identify Potential Road Safety endangering spots for all road users from the Road Engineering perspective.
2.To categorise them based on the Risks those spots pose to RoadUsers.
3.To suggest location specific road safety interventions.
4.To create a road discrepancy data base which will be shared to various organisations such as NHAI, Transport Department, Police Department, Local Municipalities, Panchayats and CityGovernments.
5.To create a baseline data of the required Road engineering interventions and monitor the effects of those interventions for a vertical study and scaling the model to the entire stretch of NH in AP.

6.3 Stages in Road Safety Audit

Safety Audit can be applied on (a) new roads and (b) existing roads. On new roads, safety audit will lead to avoiding building accident-prone situations and on existing roads, audit will lead to improved roads from the safety point of view. It should be realized that safety audits are a necessary cost, and not an additional expense. As project is audited, it provides further scope to improve/ enhance safety. In projects where there is a choice of route or standards, or there are known safety problems, the designer should discuss these with auditors at the initial stage. The safety audit shall be carried out on road and traffic improvement projects. Safety audit during construction stage is a new concept and no country has developed any checklists for carrying road safety audit during construction stage.

- New Construction
  - During feasibility study - Stage 1 Audit
  - During preliminary design - Stage 2 Audit
  - Completion of detailed design - Stage 3 Audit
  - During Construction Stage - Stage 4 Audit
  - Completion of Construction - Stage 5 Audit
- Existing Roads
  - On Existing Roads(Monitering) - Stage 5 Audit

6.4 Stage 1 Audit (During Feasibility Study)

Stage 1 is recommended for major schemes, including in urban areas, in order to influence route choice, alignment selection, standards, impact on and continuity with the existing network, junction provision, possible hazards from roadside development etc. Reviews of initial project/planning study. Important subjects for assessment at this stage will include.

1.Choice of route options

2.Alignment and ease of achieving design standards

3.Standards and cross-section

4.Effects on existing network

5.Number of junctions, their types, etc.

6.Possible hazards from roadside development

6.5 Stage 2 Audit (Completion of Preliminary Design)

Stage 2 is recommended on completion of preliminary design, to assess horizontal and vertical alignments, sight lines and layout of junctions including slip roads and lay-byes. After this stage, land acquisition may be taken up.

Examination when preliminary design is completed i.e., where the alignment has largely been decided, but can still be modified before approval. Important subjects for assessment at this stage are:

1.Project changes since Stage 1 Audit

2. Alignment

3.Cross-section

4.Arrangement of Junctions

5.Any Interim Measures

All groups of road users, including those who have special needs and users of the adjoining areas, should be taken into consideration. If there is any risk of special road safety problem occuring during the construction phase, the risk must be assessed.

6.6 Stage 3 Audit (Completion of Detailed Design)

Stage 3 is recommended on completion of detailed design and before preparation of contract documents, to assess detailed junction layout, markings, signs, signals, lighting details, etc.

Examination when detailed design is completed and the limits of expropriation have been set,but before the tender documents are prepared and tenders are invited. Vital subjects for assessment at this stage are: 1.Project changes since Stage 2 Audit

2. Detail Design of junctions

3. Design of geometries

4. Cross-fall

5.Markings and Signs

6.Side drains

7. Embankment slopes

8. Presence of clear zone

9.Traffic Signals

10. Lighting

11.Interim Measures

Tender documents must not be issued to bidders until auditing at this stage has been completed and all agreed changes have been incorporated in the project documents.

6.7 Stage 4 Audit (During Construction Stage)

Construction zone is that area of the road which is affected by the works and which affects traffic flow and safety of workers and road users. In this context it can also be called Traffic Control Zone'. In rural areas, problem at these zones is accentuated by the reduced availability of carriageway, acquisition of land for diversions, etc. In urban areas, the problems are even more acute as diversions may have to be over adjacent road street of the road network as well as the sharing of road space by different categories of road users. Traffic control zone can be divided into three major components i.e.. Advance Warning Zone, Transition Zone and Work Zone. Manual on Traffic Management at Construction Zones is published by the Indian Roads Congress as IRC:SP:55 should be referred to.

1.Examination of Terminal Transition Zone, Work Zone, Approach Transition Zone and Advance Warning Zone with respect to safety point of view.

2. Examination of safety measures adopted for workmen and road users.

3. Examination of traffic control devices adopted at construction zone.

6.8 Stage 5 Audit (Completion of Construction) (Pre-opening)

Stage 5 is recommended immediately prior to opening of scheme, involving the site staff and local traffic police in car and truck. This should take the form of driving and when appropriate, walking and/or cycling the new route. This is checked during night time also to ensure that required night time safety standards have been achieved.

1. A final review of the finished construction, to check from the standpoint of road safety that it is ready to be opened for traffic. It is particularly important to check the location and visibility of markings and other traffic control devices especially where changes were made during the construction period. The finished scheme should be assessed from the road users' point of view in daylight and in darkness.

2. After opening for one or two months, the auditor should examine whether or not road users are using the project facility in an appropriate manner.

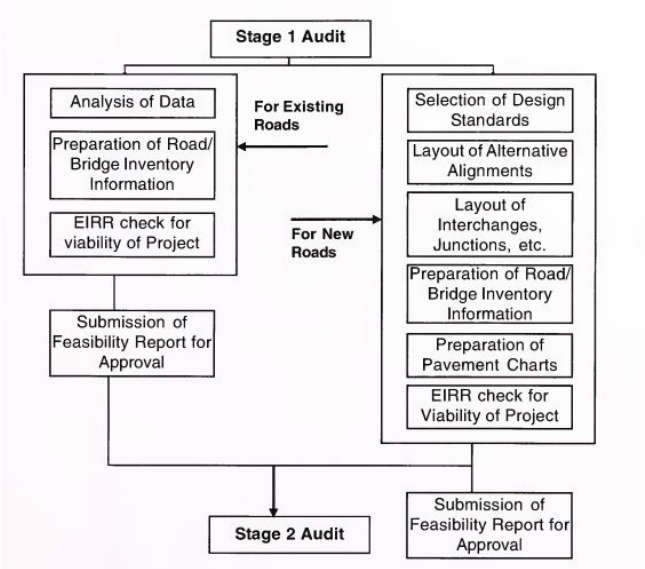

Figure 6.1: Steps involved in Stage 1 Audit

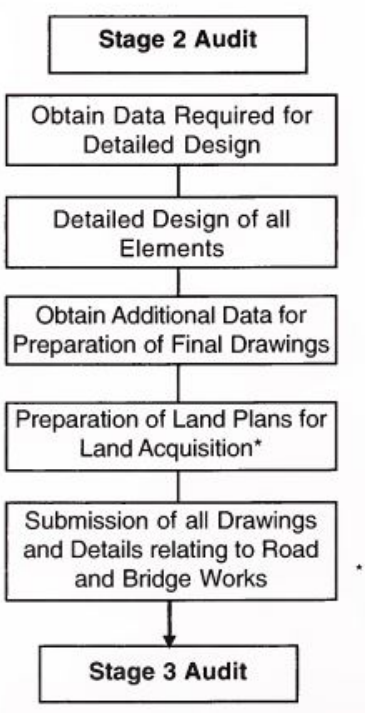

Figure 6.2: Steps involved in Stage 2 Audit

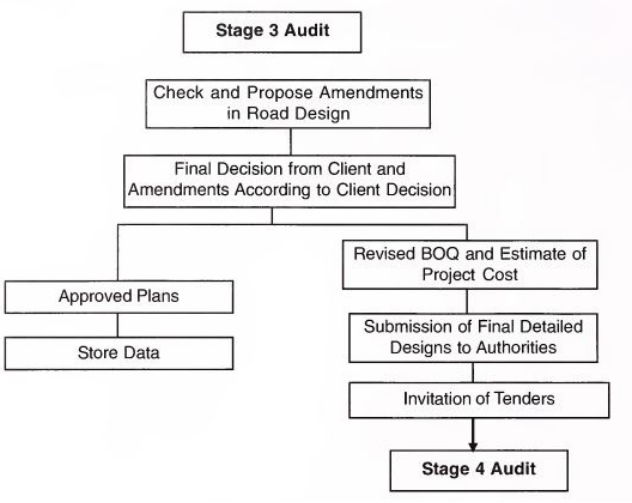

Figure 6.3: Steps involved in Stage 3 Audit

6.9 Stage 6 Audit-Audit on Existing Roads and During Operation and Maintenence of Concession Projects

Safety Audit methodology is also successful on existing roads which includes both Operation and Maintenance (O and M) of existing roads. The existing roads represent the present condition of the road after completion of construction as well as any hazardous conditions that may have been created during its lifetime such as encroachments, ribbon development or deterioration of road conditions as well as traffic conditions, etc.

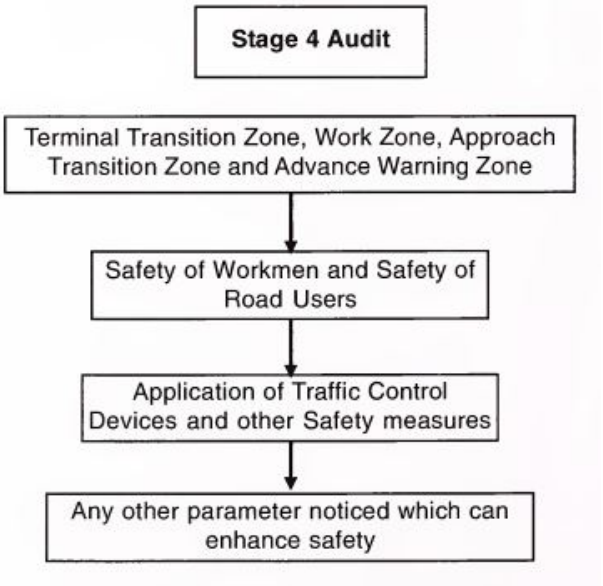

Figure 6.4: Steps involved in Stage 4 Audit

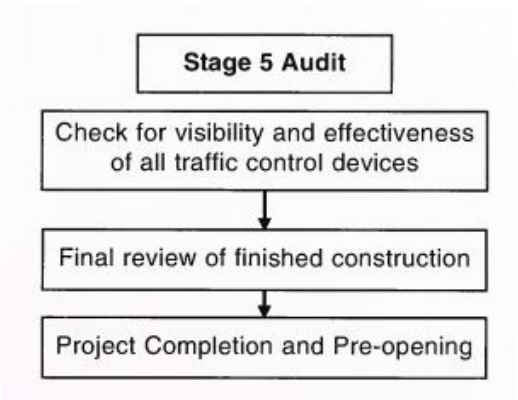

Figure 6.5: Steps involved in Stage 5 Audit

An analysis of any accident data and inspection of the scheme every year, with a view to determine whether or not road users use the scheme appropriately. Subjects for monitoring include:

a) Does the prevailing speed correspond to the design speed?

b) Are the visibility and sight distance criteria still satisfied?

c) Have any changes been made which could affect road safety?

d) For carriageway and paved shoulders examine things like any breach or blockade, roughness value, pot holes, cracking, rutting, skidding, damage to pavement, edge drop at shoulders.

e) Check the roadside furniture including road signs and markings damage to their shape or position, loss of retro-reflectivity

f) Street lighting and Highway Traffic Management System (HTMS)

g) Rest areas - cleaning, defects in electrical, water and sanitary installations.

h) Bridges - super structure, foundations, bearings, joints, etc.

6.10 Critical Road Elements selected on NH-40

Figure 6.6: Road merger

Figure 6.7: Road diverger

Figure 6.8: Road intersection

Figure 6.9: Road curve

Figure 6.10: Culverts

Figure 6.11: Gap In Median

Figure 6.12: Truck/ Bus Layby

Figure 6.13: Road side Institutions

Figure 6.14: Road side Piligrim center

6.11 Safety Issues

6.11.1 Curve

DISCREPANCIES

1. Speed limit board is not erected.

CHAINAGE	299.500(LCW)
LOCATION	SPIN MILL
MITIGATION POINT	CURVE
LONGITUDE	78.36748
LATITUDE	15.50662
ALTITUDE	741FT

2. Chevron marking are not provided

INTERVENTIONS

1. Speed limit board is to be provided.

2. chevron marking are to be provided.

6.11.2 Intersection

CHAINAGE	323.700
LOCATION	BETAMCHARLA CROSS
MITIGATION POINT	INTERSECTION
LONGITUDE	78.177959
LATITUDE	15.574491
ALTITUDE	1234 ft

DISCREPANCIES

1. Intersection sign board is not provided

INTERVENTIONS

1. Intersection sign board is to be provided

6.11.3 Minor bridge

CHAINAGE	304.4
LOCATION	SRBC CANAL
MITIGATION POINT	MINOR BRIDGE
LONGITUDE	78.326843
LATITUDE	15.519451
ALTITUDE	781 ft

DISCREPANCIES

1. Cat eyes are not provided.
2. Median wall not closed.
3. Speed limit boards not provided

INTERVENTIONS

1. Cat eyes are to br provided.
2. Median wall to be closed.
3. Speed limit boards to be provided

6.11.4 Diverger

CHAINAGE	294.35 LCW
LOCATION	NEAR SANTHIRAM HOSPITAL
MITIGATION POINT	DIVERGER
LONGITUDE	78.413796
LATITUDE	15.492991
ALTITUDE	686ft

DISCREPANCIES

1. There is no separation(median/kerb) between service road and NH.

2. Deceleration lane not sufficient.

INTERVENTIONS

1. separation(median/kerb) is to be provided between service road and NH.

2. Deceleration lane to be provided.

6.11.5 Culvert

CHAINAGE	294.9 RCW
LOCATION	INFRONT OF MALAVIKA DEVELOPERS
MITIGATION POINT	CULVERT
LONGITUDE	78.040898
LATITUDE	15.49507
ALTITUDE	696ft

DISCREPANCIES

1. . Cat eyes are not provided near culverts.

2. Rumble strips are not provided on national highway approaching culvert

3. metal beam crash barrier is not provided on national highway approaching culvert.

INTERVENTIONS

1. Cat eyes are to be provided near culverts .

2. Rumble strips are to be provided on national highway approaching culvert.

3. metal beam crash barrier is to be provided on national highway approaching culvert

6.11.6 Gap In Median

CHAINAGE	296.380 LCW
LOCATION	NEAR BALAPANURU METTA
MITIGATION POINT	GAP IN MEDIAN
LONGITUDE	78.395343
LATITUDE	15.499421
ALTITUDE	696 ft

DISCREPANCIES

1. Cat eyes and road signs are not provided.
2. Sufficeint illumination is not provided

INTERVENTIONS

1. cat eyes and road signs are to be provided
2. sufficient illumination is to be provided.

6.11.7 Minor bridge

DISCREPANCIES

1. . Metal beam crash barrier is not closed..
2. Rumble strips are not provided .

INTERVENTIONS

1. Metal beam crash barrier is to be provided.
2. Rumble strips are to be provided on national highway approaching culvert .

CHAINAGE	296.694 RCW
LOCATION	NEAR BALAPANURU METTA
MITIGATION POINT	MINOR BRIDGE
LONGITUDE	78.393361
LATITUDE	15.50015
ALTITUDE	689 ft

6.11.8 Curve

CHAINAGE	312.000
LOCATION	Near Panyam Reserve Forest
MITIGATION POINT	curve
LONGITUDE	78.271503
LATITUDE	15.549149
ALTITUDE	932ft

DISCREPANCIES

1. Speed limit board is not provided.

2.Cat eyes is not provided.

INTERVENTIONS

1.Speed limit board is to be provided.

2.Cat eyes is to be provided.

6.11.9 Culvert

CHAINAGE	316.839
LOCATION	Thammaraj Palli
MITIGATION POINT	culvert
LONGITUDE	78.223695
LATITUDE	15.54917
ALTITUDE	955ft

DISCREPANCIES

1.Narrow bridge sign board is not provided.

2.Cat eyes are not provided.

3.Bridge width is lesser than carriage way width.

INTERVENTIONS

1.Narrow bridge sign board is to be provided.

2.Cat eyes are to be provided.

3.Bridge to be widened.

6.11.10 Curve

CHAINAGE	320.040
LOCATION	Thammaraju Palli Ghat
MITIGATION POINT	curve
LONGITUDE	78.2029
LATITUDE	15.554
ALTITUDE	1076ft

DISCREPANCIES

1.Curve sign board is not provided.

2.Cat eyes are not provided.

INTERVENTIONS

1.Curve sign board is to be provided.

2.Cat eyes are to be provided.

6.11.11 Gap in median

CHAINAGE	323.700
LOCATION	Betamcahrla Cross
MITIGATION POINT	Gap In Median
LONGITUDE	78.177959
LATITUDE	15.574491
ALTITUDE	1234ft

DISCREPANCIES

1.Speed limit sign board is not provided.

2.Sufficient illumination is not provided.

3.cat eyes are not provided.

INTERVENTIONS

1.Speed limit sign board to be provided.

2.Sufficient illumination is to be provided.

3.cat eyes are not provided.

6.11.12 Minor bridge

CHAINAGE	323.874
LOCATION	Somayajula Palli
MITIGATION POINT	Minor Bridge
LONGITUDE	78.1039
LATITUDE	15.3435
ALTITUDE	1211ft

DISCREPANCIES

1. Sufficient illumination is not provided.
2. cat eyes are not provided.

INTERVENTIONS

1. Sufficient illumination is to be provided.
2. cat eyes are not provided.

6.11.13 Gap in median

CHAINAGE	335.300
LOCATION	Orvakal
MITIGATION POINT	Gap In Median
LONGITUDE	78.1030
LATITUDE	15.4040
ALTITUDE	1113ft

DISCREPANCIES

1. Sufficient illumination is not provided.
2. cat eyes are not provided.

3.Gap in median sign board is not provided.

4.Rumble strips are not provided.

INTERVENTIONS

1. Sufficient illumination is to be provided.
2. cat eyes are not provided.

3.Gap in median sign board is to provided.

4.Rumble strips are to be provided.

6.11.14 vehicle under pass

CHAINAGE	335.756
LOCATION	Orvakal
MITIGATION POINT	Vehicle under pass
LONGITUDE	78.1027
LATITUDE	15.4459
ALTITUDE	1094ft

DISCREPANCIES

1. Sufficient illumination is not provided.
2. cat eyes are not provided.

3.Delineators are not provided.

4.Rumble strips are not provided.

INTERVENTIONS

1. Sufficient illumination is to be provided.
2. cat eyes are not provided.

3.Delineators are to be provided.

4.Rumble strips are to be provided.

6.11.15 Curve

CHAINAGE	335.950
LOCATION	Orvakal
MITIGATION POINT	Curve
LONGITUDE	78.1028
LATITUDE	15.4052
ALTITUDE	1104ft

DISCREPANCIES

1.Curve sign board is not provided.

2.Cat eyes are not provided.

INTERVENTIONS

1.Curve sign board is to be provided.

2.Cat eyes are to be provided.

6.12 Summary

In this chapter road safety issues related to the design, Curves, intersection and traffic signs are discussed. Observations during RSA also included.

Chapter 7

CONCLUSIONS

7.1 General

Road and transportation has become an integral part of every human being. The tremendous growth of both road network and road traffic in India has minimized the distances but it has on the other hand increased the life risk. This accident situation in general is serious. From the study carried out in the Nandyal to kurnool on NH-40 for road safety audit, the following conclusion are summarized after carrying out different surveys and physical observations of the situations pertaining to the different typical conditions and completing the detailed analysis as shown in above chapters.

7.2 Conclusion

7.2.1 Based on study area

From this study we have collected required data of study area . We have given some suggestions regarding to discrepancies

- .From the accident data
  - fatality is 20% of the total accidents .
  - grievous injury is 29.9% of the total accidents.
  - minor injury is 50% of the total accidents .
  - motor cycles ,autos,cars are mostly involved in the accidents.

- motor cycles involved 25% of total accidents.
- autos involved 22% of total accidents.
- cars involved 22% of total accidents.
- buses and trucks are involved 7% of accidents in each of total accidents.
- heavy trucks involved in 10% of total accidents.
- tractors involved in 4% of total accidents.
- bicycles involved in 3% of total accidents.
- the maximum accidents involved in 2016.
- the minimum accidents involved in 2012.
- the age limit for the maximum accidents is 30-34

7.2.2 Future Scope

This study is carried out from Nandyala to Kurnool on NH-40; these can be extended to the entire stretch of the highway in order to carry out road safety audit for the benefit of the road users.

Accident prone stretches can also be found out from Accident Rate and Accident Frequency method.

7.2.3 Based on Safety Issueses

From the study area, we have identifeid some location where the requirements are not provided. especially in case of curves there are may discrepancies like cate eyes , chevron markings are not provided and those are very important in safety cosiderations.

S.NO	Chainage	Improvements/Recommendation
1	323-640	Provide cat eyes Provide rumble strips
2	322.586	Paved shoulder has to increase Widening of the culvert
3	322.290	Provide Thermoplastic bar markings Illumination has to provide
4	319.032	Provide centre line marking Provide edge line markings
5	318.717	Provide cat eyes
6	318.200	Provide metal crash barrier closed with smooth ends
7	316.839	Bridge to be widen
8	316.594	Provide illumination Provide objective marking Provide edge line markings Provide cat eyes
9	314.730	Provide cat eyes
10	313.600	Replace the Metal crash barrier
11	319.291	Provide cat eyes
12	306.800	Provide bus bay
13	306.600- 306.700	Provide illumination
14	309.062	Provide Horizontal Crash barriers(for existing metal barrier)
15	306.800-307.300	Provide service road nearer to the pinna puram village.Particulary in this location vehicles are coming in opposite direction. (or) provide PUP/VUP
16	301.672	Provide cat eyes
17	300.056	Repair work has to do on median (median cutting at near HP Gas)
18	299.600	Bus bay under construction Provide cat eyes
19	299.500	Provide cat eyes Earth dump has to level at santhiram medical college
20	297.500	Provide cat eyes
21	293.600-900	Provide bar cards
22	291.900	Repair the existing pavement cracks Hoardings has to clear.

S.NO	Chainage	Improvements/Recommendation
1	295.200	Provide cat eyes Provide center line markings Provide hazardous Markings
2	296.380	Provide cat eyes Provide road signs
3	296.600	Provide vehicle under pass (or) pedestrian under pass at Balapur location
4	298.640	Provide Metal crash barrier Provide cat eyes Provide solar lights Provide cameras
5	298.850	Under Construction
6	299.500	Provide cat eyes
7	300.650	Provide cat eyes
8	302.000-303.300	Under construction
9	306.800	Provide Foot over bridge
10	315.035	Widening of road due to narrow bridge
11	315.866	Under Construction
12	316.180	Provide vehicle under pass
13	317.000	Provide cat eyes
14	318.200	Provide arrow markings Improve soil condition on earthen shoulders
15	318.216	Provide cat eyes
16	319.034	Provide cat eyes Improve soil conditions on earthen shoulders Riding Quality has to improve

17	319.150	Provide Object markings on culvert Lay the pavement markings Improve the riding quality Provide cat eyes
18	320.080	Repair the metal crash barrier
19	321-321.600	Provide metal crash barrier on both sides
20	323.250	Provide illumination near power station
21	323.700	Provide cameras Provide rumble strips (or) Thermoplastic plastic bar markings Provide Cat eyes Approach road construct properly
22	324.400	Provide bus layby sign board Provide cat eyes
23	325.600	Provide cat eyes Provide transverse bar markings
24	326.844	Provide hazard markings Provide lane markings

25	335.050	Provide merger sign board Provide rumble strips
26	336.000	Provide merger sign board Provide speed breakers
27	336.140	Provide transverse bar markings Provide cat eyes Provide crass barriers along approach road Provide hazard markings
28	337.450	Provide illumination Provide chevron boards
29	340.183	Provide delineators Provide cat eyes
30	341.400	Provide illumination Provide road safety cameras Provide cat eyes Provide gap in median sign board
31	343.410	Provide illumination Provide rumble strips Provide gap in median sign board
32	343.785	Provide proper drainage system Provide cat eyes
33	345.170	Provide rumble strips Provide road safety cameras Provide gap in median sign board
34	345.200	Provide adequate road markings Provide illumination Provide speed breakers in service road

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Appendix-1

Inventory Survey					
Sr	Location	Carriageway width in m	Median width in m	shoulder	
				Paved	Unpaved
1	NH-40 LCW				
	NH-40 RCW				

Figure 7.1: inventory survey

Aappendix-2

Checklists of critical road elements selected on NH-40

Critical Road Elements

1. Road Mergers/Divergers (31 Qs)
2. Road Intersections (50 Qs)
3. Road Curves (36 Qs)
4. Rail/Road/River Over bridges/Culverts (36 Qs)
5. Gap in Median (36 Qs)
6. Truck/Bus Laybay (36 Qs)
7. Road side Industries/Institutions (54 Qs)
8. Road side Pilgrim Center/Shandy (46 Qs)

Data Collection Template

Summary Sheet																										
Location Details																										
K M Stone			Discrepancy point			Location / Land Mark			Longitude			Latitude			Altitude			LCW/RCW			Others					
Identified Discrepancies																										
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54

Answers

- Item required and provided - Y
- Item required but not provided - N
- Item not required - NA

20 Common Questions

1. Are rumble strips provided along NH?
2. Is concrete pavement provided?
3. Is paved shoulder of width minimum 1.5 (or 2m when earthen shoulder is missing) provided?
4. Is earthen shoulder of 2m width provided?
5. Is earthen shoulder at same level as paved shoulder?
6. Is surface of earthen shoulder Hard and Smooth?
7. Are OFC cables safe?
8. Is enough illumination provided?
9. Is enough sight distance available? (Free from poles, columns, signs, trees, vegetation etc.)
10. Are proper signages provided?
11. Are proper all weather pavement markings provided?
12. Are proper signals provided?
13. Are cat eyes provided at important stretches ?
14. Are delineators provided at important stretches?
15. Are there any thorny bushes/trees or other objects on road side, which are likely to hurt passengers?

16. Are there any bushes/trees or other objects by the road side obstructing the road furniture?

17. Are road safety cameras provided?

18. Is the location free from hoardings within ROW?

19. Are hoardings free from RGB colors?

20. Is illumination provided to hoardings acceptable? (It should not distract drivers).

Mergers/Divergers

1. Is service road of width minimum 7m provided?
2. Are service road transition lanes of width minimum 5.5 Mts provided?
3. Are speed breakers provided in the Service road near to merger?
4. Is 3.5 m wide acceleration (95m long) /deceleration lane (75 m long) provided?
5. Is the merger free from entry to NH, at the left hand curve?
6. Is service road provided with footpaths of width minimum 1.5 m and drainage?
7. Are the footpath ends suitable for differently abled persons?
8. Are crash barriers provided to protect the lighting poles in the median whose width is less than 2 m?
9. Is the merger free from gap in median?
10. Is fuel station at least 500 m away from merger?
11. Is Dhaba/Property, at least 100 m away from merger in urban areas/300 m away in other locations?

Intersections

1. Is junction controlled by proper traffic signals?
2. Are speed breakers provided on the approach roads joining the NH?
3. Is gap in median provided at the intersection?
4. If the above answer is yes, is the median provided at the suitable position?
5. Is median gap of minimum 18 to 20m maintained?
6. Is shelter lane of width minimum 3.5m provided at median gap in each carriage way?
7. Is the road channelized/Road markings provided for different streams of traffic?
8. Is a median width of 2.5m in built up area, 5m at other areas provided?
9. When width of median is 2.5 m, are anti-glare measures (plastic sheets) taken?
10. Is kerb of sufficient height (225mm) provided?
11. Is kerb shyness width of 0.5 m provided?
12. Are rumble strips on kerb shyness s?
13. Any attenuators placed at the median gap?
14. At gap in median, is the median free of vegetation up to 100 m on either side?
15. Is the median paved up to 100 m from the gap in median?
16. Are crash barriers provided to protect lighting poles in the medians of width less than 2 m?
17. Is fuel station existing:
    - at least 1000 m away from intersection;
    - at least 300 m away from intersection with rural roads/ approach roads to private and public properties;
    - at least 100 m away from intersection in Urban areas with population one lakh and above ?

18. Is Dhaba/Property near intersection/median opening, located at least 100 m away in urban areas/300 m in other locations?

19. Is safe approach of junction roads provided into Highway?

20. Are crash barriers provided to protect lighting poles in the medians of width less than 2 m?

21. Is fuel station existing a) at least 1000m away from intersection with NHs/SHs/MDRs; b) at least 300 m away from intersection

22. with rural roads/ approach roads to private and public properties; c) at least 100 m away from intersection in Urban areas with

23. population one lakh and above ?

24. Is Dhaba/Property located at least 100 m away in urban areas/300 m in other locations?

25. Is safe approach of junction roads provided into Highway?

26. Is there any underpass/service road provided to the intersection?

27. Is the location of underpass suitable conditions?

28. Is service road/underpass to NH required? If the answer to the above question is YES, suggest a suitable Grade separated Structure:

29. Vehicle Underpass (VUP)

30. Light Vehicle Underpass (LVUP)

31. Vehicle Overpass (VOP/ Elevated Corridor)

32. Pedestrian Underpass (PUP)

33. Cattle Underpass (CUP)

34. Rail Over-bridge (ROB)

35. Only Service Roads

Curves

1. Do the horizontal & vertical alignments fit together?
2. Is the curve free from sudden change in road width?
3. Are the horizontal and vertical clearances visible?
4. Is height of vegetation less than 60 cm at curves, up to 20 m on median?
5. Is a median width of minimum of 1.20 m/2.5 m in built up area; 5 m at other areas provided?
6. Is proper crash barrier provided along the curve on the outside edge?
7. Are rigid barriers placed at specified distances for all groups of road users?
8. Is crash barrier free from damage/wrong Position?
9. Any flexible road median/crash Barriers provided to reduce the crash force?
10. Are rumble bar codes provided on paved shoulders?
11. Is necessary extra shoulder width provided at curves on outside edge?
12. Is proper drainage system provided at curves?
13. Are attenuators placed at the end of crash barrier?
14. Are the outside/inside edges of the curve free from properties/encroachments?
15. Are chevron boards provided on curves?
16. Is the left hand curve free from approach roads?

Bridges

1. Are numbers of lanes in approach road matching with lanes on bridge?
2. Is the NH road free from sudden changes in width?
3. If the answer to above question is NO, is attenuator provided at the starting edge of the Bridge?
4. Are rumble bar codes laid on paved shoulder of approach road to warn the drivers?
5. Is the approach road surface vertically aligned for smooth drive on to the Bridge/Culvert?
6. Do the slab expansion joints laid on the bridge, ensures smooth drive?
7. Is Foot Path of width minimum1.5 Mts provided at Bridges/Culverts?
8. Are the footpath ends designed to suit requirements of differently able persons?
9. Is guard rail of height minimum 1 Mt provided along the Foot Path on carriageway side?
10. Is proper drainage system maintained at Bridges/Culverts?
11. Are proper RCC crash barriers built on Bridge?
12. Are impact absorbing flexible crash barriers provided?
13. Are crash barriers provided at approach roads?
14. If the answer of the above question is YES, are crash barriers free from maintenance?
15. Are rigid barriers placed at specified distances for all groups of road users?

Gap In Median

1. Is gap in median provided at suitable location?
2. Is the road channelized/road marking provided for different streams of traffic?
3. Is shelter lane of width minimum 3.5m provided at median gap in each carriage way up to 100m?
4. Is a median width of minimum of 1.20/2.5m in built up area; 5 m at other areas provided?
5. When width of median is 2.5m or less, are anti-glare measures (plastic sheets) taken?
6. Is median of height of minimum 225mm provided?
7. Is kerb shyness of minimum 0.5m provided?
8. Are rumble bar codes on kerb shyness provided to alert drivers?
9. Is median gap of min 18 to 20m maintained?
10. Any attenuators placed at the median gap?
11. At gap in median, is the median free of vegetation up to 100m on either side?
12. Is the median paved up to 100 m from the gap in median?
13. Are crash barriers provided to protect the lighting poles in the medians of width less than 2m?
14. Is fuel station existing at least:
    - 1000 m away from gap in median
    - 300 m away from approach roads
    - 100 m away from gap in median in Urban areas
15. Is Dhaba/Property near median opening located at least 100 m away in urban areas/300 m in other locations?
16. Is minimum distance of 500m in built up area/ 2Km in other areas maintained between two Median gaps?

Truck /Bus Lay Bays

1. Is lay by provided at suitable location?
2. Is Acceleration/Deceleration lane of width minimum 3.5m provided?
3. Is the road channelized/road marking provided for different streams of traffic?
4. Is outside/inside edge of the curve free from lay by?
5. Is Bus lay by away from bridges, Underpass, etc.?
6. Is guard rail of height minimum 1 m provided at bus lay by platform/footpath on the carriage way side?
7. Is shelter provided in bus lay bay for passengers?
8. Is safe pedestrian crossing/footpath provided at bus bay including access to differently abled persons?
9. Is lay bay away from road intersection/merger?
10. Is lay bay provided with acceleration and deceleration lanes?
11. Is the merger free from entry to NH, just prior to the start of left hand curve?
12. Is fuel station located at least 500 m away from bay?
13. Is lay bay separated with an island?
14. If the answer of the above question is YES, is attenuator provided at the starting edge of the island?
15. Is a truck lay bay provided at every 30 km along NH?
16. Is truck Amenities center provided at every 100 Km along NH?

Road side Industries/Institutions

1. Is service road of width minimum 7 m provided?
2. Is service road provided with footpaths of width minimum 1.5 m and drainage?
3. Is Bus bay provided for passengers?
4. Is guard rail of height minimum 1 m provided at bus lay bay platform on the carriageway side?
5. Is shelter provided in bus lay bay for passengers?
6. Is adequate parking area provided for trucks/buses at industries/institutions?
7. Is gap in median provided at the junction?
8. If Gap in Median is provided, is it at a suitable location?
9. Is median gap of minimum18 to 20 m maintained?
10. Is shelter lane of width minimum 3.5 m provided at median gap in each carriage way?
11. Is the road channelized/Road markings provided for different streams of traffic?
12. Is a median width of 2.5 m in built up area, 5 m at other areas provided?
13. When width of median is 2.5 m, are anti-glare measures (plastic sheets) taken?
14. Is Kerb of sufficient height of 225mm provided?
15. Is kerb shyness width of 0.5 m provided?
16. Are rumble strips provided on kerb shyness drivers?
17. Any attenuators placed at the median gap?
18. At gap in median, is the median free of vegetation up to 100 m on either side?
19. Is the median paved up to 100 m from the gap in median?
20. Are crash barriers provided to protect the lighting poles in the medians of width less than 2mts?
21. Is there clear road visibility to NH users at the junction?

22. Is the industry/institution built away from the building line and control line of 75 m?

23. Is the property distance maintained minimum 300 m away from junctions?

24. Is fuel station existing at least :

    - 1000 m away from intersection;
    - 300m away from intersection with rural roads/ approach roads to private and public properties;
    - 100 m away from intersection in Urban areas

25. Is Dhaba/Property near intersection/median opening, located at least 100 m away in urban areas/300 m in other locations?

26. Is there any requirement of merging with service roads/under pass to NH?

27. If the answer to the above question is YES, suggest a suitable Grade separated Structure:

28. Vehicle underpass

29. Light vehicle underpass

30. Vehicle overpass or elevated corridor

31. Pedestrian underpass

32. Cattle underpass

33. Road over bridge

34. Only service road

Road side Pilgrimage/Shandy

1. Is service road of width minimum 7 mts provided?
2. Is service road provided with footpaths of width minimum 1.5 m and drainage?
3. Whether proper Bus bay provided for passengers?
4. Is guard rail of height minimum 1m provided at bus lay bay platform on the carriage way side?
5. Is shelter provided in the bus lay bye?
6. Is adequate parking area provided of all types of vehicles?
7. Is gap in median provided at the junction?
8. If the above answer is YES, is the median provided in a suitable location?
9. Is median gap of minimum18 to 20 m maintained?
10. Is shelter lane of width minimum 3.5 m provided at median gap in each carriage way?
11. Is the road channelized/Road markings provided for different streams of traffic?
12. Is a median width of 2.5m in built up area, 5m at other areas provided?
13. When width of median is 2.5m, are anti-glare measures (plastic sheets) taken?
14. Is kerb of sufficient height of 225mm provided? Is kerb shyness width of 0.5m provided?
15. Are rumble strips on kerb shyness erected to alert drivers?
16. Any attenuators placed at the median gap?
17. At gap in median, is the median free of vegetation up to 100 m on either side?
18. Is the median paved up to 100 m from the gap in median?
19. Are crash barriers provided to protect the lighting poles in the medians of width less than 2 m?
20. Is there clear road visibility to NH users near the Pilgrim Center/Shandy?
21. Is the pilgrimage/shandy built away from the building line i.e. 40 Mts from center of the median in non-urban areas, 35 Mts in

22. urban areas, and control line of 75 Mts on either side of the road?

23. Are appropriate barriers provided to ensure free flow of traffic on NH?

24. Is fuel station existing at least :

    - 1000 m away from intersection;
    - 300m away from intersection with rural roads/ approach roads to private and public properties;
    - 100 m away from intersection in Urban areas

25. Is Dhaba/Property near intersection/median opening, located at least 100 m away in urban areas/300 m in other locations?

26. Is there any requirement of merging with service roads/under pass to NH?

27. If the answer to the above question is YES, suggest a suitable Grade separated Structure:

28. Vehicle underpass

29. Light vehicle underpass

30. Vehicle overpass or elevated corridor

31. Pedestrian underpass

32. Cattle underpass

33. Road over bridge

34. Only service road

General Discrepancies

These discrepancies found on the highway other than those covered in the regular road elements and mentioned below:

1. Absence of rumble strips at critical locations.
2. Absence of concrete pavement required.
3. Absence of paved shoulder of required width.
4. Absence of earthen shoulder of required width.
5. Presence of level difference between earthen and paved shoulders.
6. Earthen shoulder is not stiff.
7. Road side OFC is creating obstruction.
8. Proper illumination is not provided.
9. Presence of obstructions, like Poles, columns, Sign boards, trees, vegetation and any other road furniture which obstructs sight distance of drivers.
10. Road markings are insufficient or inappropriate.
11. Road signs are wrongly placed or absent altogether.
12. Proper signals not provided as per the location specialty.
13. Cat eyes required but not provided.
14. Delineators not provided.
15. Delineator is missing or not spaced properly.
16. Presence of thorny bushes/trees or other objects by the road side which are likely to hurt passengers.
17. Presence of thorny bushes/trees or other objects by the road side which are likely to reduce sight distances or lock road furniture.
18. Adequate bushes not provided in the median.
19. Road safety cameras are required but not provided.

20. Hoardings are present close to / in the ROW.
21. Hoardings are found with RGB colors
22. Illumination provided to Hoardings is distracting the drivers.
23. Unauthorized bus stops/Parking found along NH.
24. Encroachment found in the Service Road, Laybys and ROW.
25. Posted speed limits are not safe.
26. Unauthorized pedestrian crossings that are dangerous.
27. Adjacent approach roads are very close to each other.
28. Fuel stations very close to each other.
29. Sudden shrinking of road width.
30. Unauthorized median openings.
31. Lighting poles in the medians are not protected by crash barriers.
32. The place is suitable for accommodating a helipad.
33. The place is suitable for building an enforcement station.
34. Location requires segregation of lanes with gantries and cameras.
35. Location requires HOV lanes.
36. Presence of wine shops/ belt shops/country liquor.
37. Location suitable place for Amenities Centre.
38. 2m paved shoulder not maintained in built-up area.
39. Construction/structures inside building line.
40. Existing underpass is not at a suitable location.
41. Encroachments found in the ROW and departments involved.
42. Poles, columns, sign boards, trees, vegetation and other road furniture, obstructing sight clearance of the drivers, in the service roads.

43. Frequent accidents occurring due to road factor.

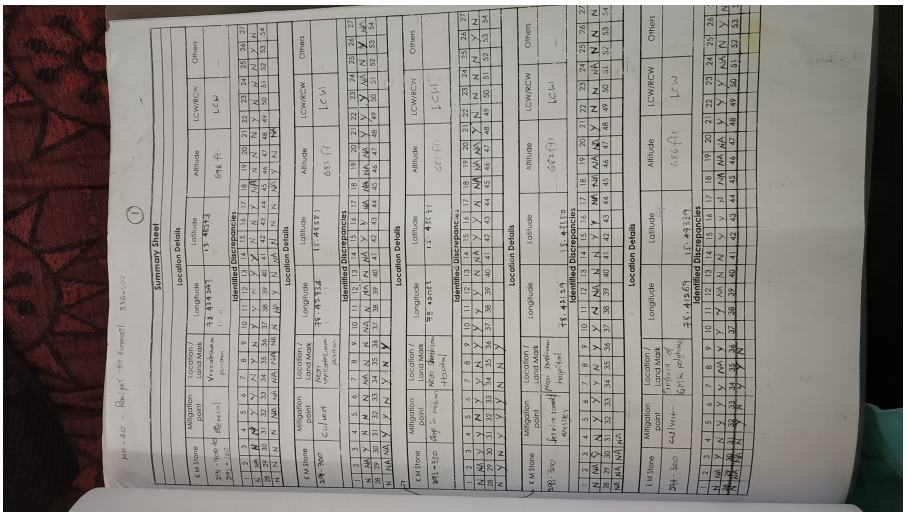
44. Crash barriers need maintenance.

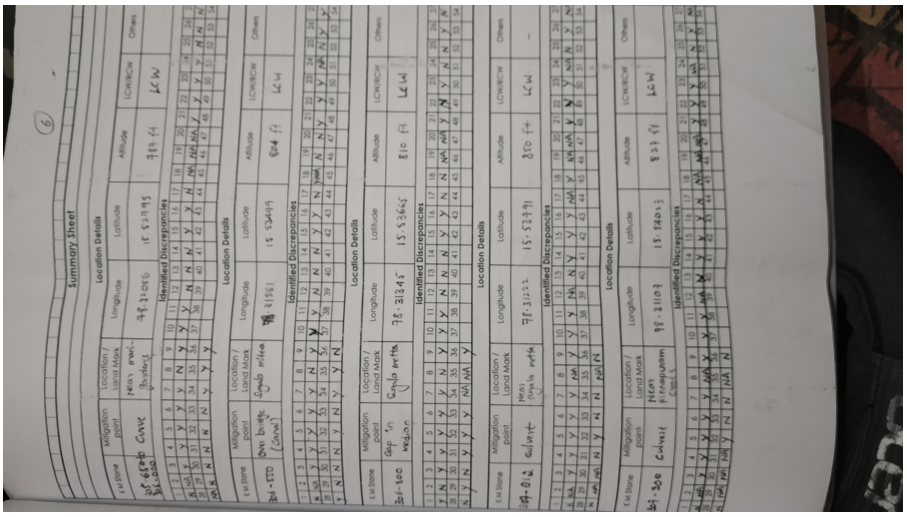
45. Built-up area (200 m or more) not provided with a service road.

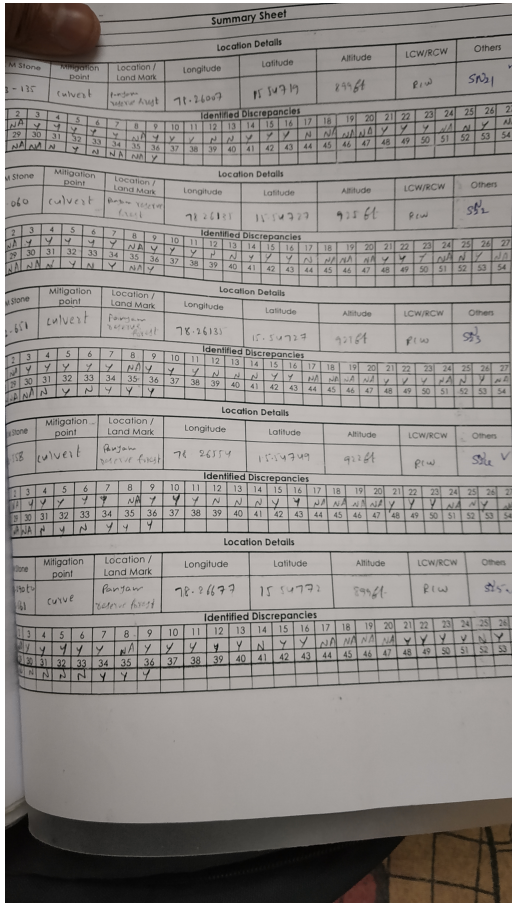
46. Approach road is unauthorized.

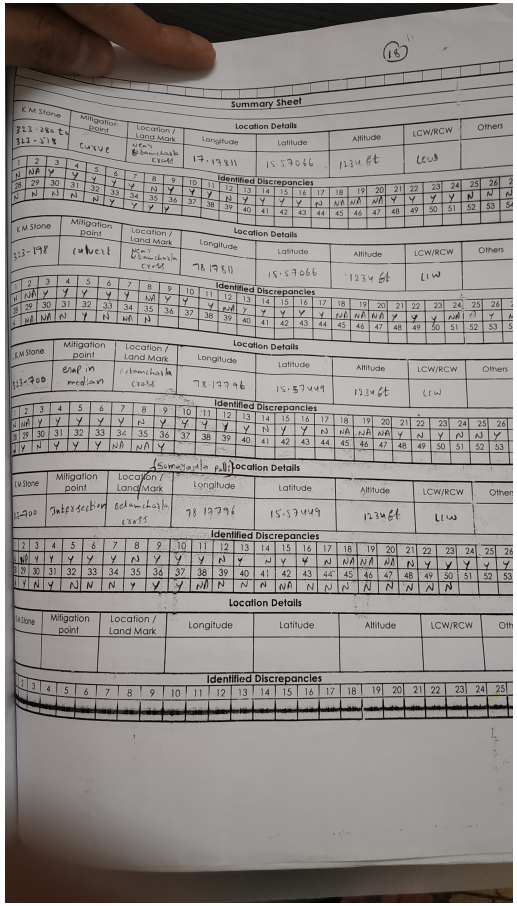
47. Rigid barriers are required but not provided.

Data collection






Summary Sheet
Location Details
Identified Discrepancies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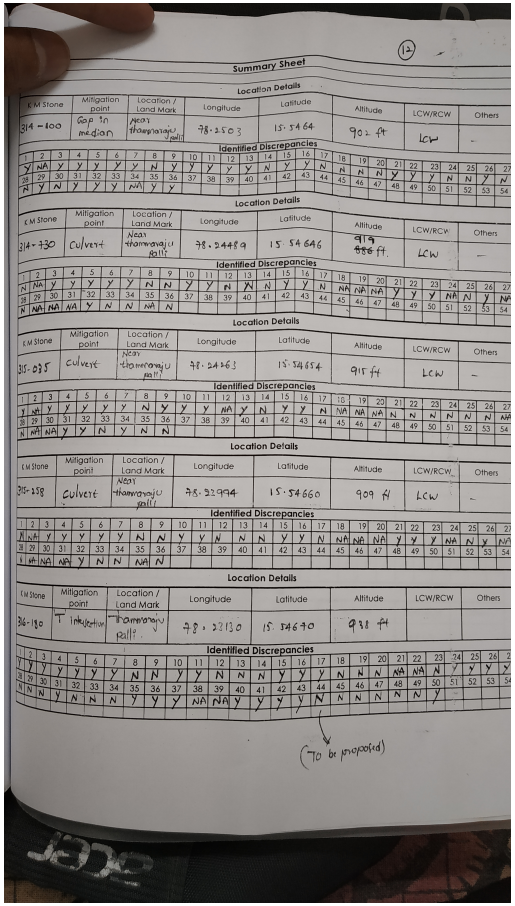
Summary Sheet
Location Details
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