International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 9 Issue 7 ǁ 2021 ǁ PP. 38-46

"Road Safety Audit": A Study for NH-52 in Aurangabad District.

Er. Rahul Patil Prof. Kunal Pawar
P.G. Student *Assistant Professor*
Department Of Civil Engineering, Sandip University Nashik.

ABSTRACT
Now a day, in every 10 minutes, one human life is lost due to road crashes. In the world, India has world's largest heavy traffic and accidents also. It is necessary to provide the safety to roads. Road Safety Audit (RSA) is a procedure or method in which identification of existing or future road on basis of safety issues and provision of safety remedial measures on it.
In this study, the section of road from Four/Six Laning of Karodi (km 320.104) to Telwadi (km 375.000) road section of NH-211 (new NH No. 52) in the state of Maharashtra under NHDP Phase lV-B on EPC Mode" is undertaken. Road taken having considerable traffic during day and night time and some black spots on the road where accidents takes place continuously.
The safety is aimed at the Road Authorities inspecting, Engineers, Consultants, Contractors, Concessionaires concerned with road projects, irrespective of category of road or the area where they work. The application of Safety principles in the provision, improvement and maintenance of roads as means of accident prevention can be established through road safety audit. Thus, the purpose of this audit is to ensure that road users would be exposed to minimal risks of accidents in both new roads and existing roads.
Keywords: *Road safety, Accident, Four laning of National Highway.*

Date of Submission: 06-07-2021 Date of acceptance: 19-07-2021

I. INTRODUCTION

Road is a way or course between the at least two spots associated for voyaging and transportation of human, merchandise, and so on by vehicles like bikes, transports, trucks beats cycles, for example 2 wheelers and 4 wheelers.

In the year 1943, the meeting of Chief Engineers of Focal and state legislatures of India, at Nagpur, passed on by the focal Government, make a leveled arrangement of plan of street improvement for India called 'Nagpur street Plan' by Indian street Congress (IRC). As indicated by it, it is characterized as National Expressway (NH) , public

Interstates (SH), Significant Region Streets (MDR), other Region Streets (ODR), Town Streets (VR). India having 5.5 million km street network which is 2 Nd biggest on the planet. Street transportation is the only one mode of transportation which gives greatest administrations. Service of Street Transport and Parkways (MORTH) of India have taken up the obligation of building great quality streets and interstates inside the country. As indicated by year 2016-17, 16,271 Km of NH were chosen to develop and 8.231 Km were developed. In 2016-17, MoRTH built the 22 Km interstate each day. They set focus of 40 Km of interstate for every day by monetary year 2017-18. On 31st Walk 2016, every day by monetary year 2017-18. On 31st Walk 2016 India has 2 Nd biggest street organization of more than 6603293 Km on the planet. Consistently 16 people groups were kicked the bucket by street mishaps on Indian Streets that mean 1 demise happens in at regular intervals. Concurring Public Wrongdoing Record Agency (NCRB) report of year 2015, 53 street, mishaps happened each hour, wherein 17 people were executed. It is vital that the streets built or which are to be built in future were as indicated by legitimate configuration, measures to be taken for mishap anticipation, arrangement of security signs and images, appropriate street markings, and so forth and giving better admittance to administrations, and simplicity of transportation and opportunity of development to individuals.

II. OBJECTIVES OF THIS PROJECT.

The main objectives of RSA are to minimize the risk of crashes occurring on an existing road/ a new road project and to minimize the severity of any crashes that do occur or likely to occur.

There are other objectives too, including;

- To minimize the risk of crashes occurring on adjacent roads (especially at intersections).
- To recognize the importance of safety in road design so that the needs and perceptions of all road users are met, and to achieves a balance between needs where they may be in conflict.

- To reduce the long-term costs of a new road project, bearing in mind that unsafe designs may be expensive to occurs at a later stage.
- To enhance the awareness of road safety engineering principles by all involved in the process of planning, designing, construction, operating, managing and maintaining roads and highways.
- To advance the awareness of providing safe and schemes for non-motorized as well as motorized road users.

III. PROBLEM DEFINITION

From above literature review following uncertainties like gap in study of role of bad roads in accidents in identified. Hence the further project works aims to study the Road Safety Audit (RSA) from the traffic engineering and analysis of it as per new definition of bad road by Hon'ble Bombay High Court. And final aims to suggest preventive and mitigative measures for the same.

IV. METHODOLOGY

Every work has a specified methodology. Safety Audit can be taken on new roads, existing or constructed roads. The findings from the Safety Audit during construction stage carried out for Four/Six laning of Karodi to Telwadi (from Km. 320.640 to 375.000) road section of NH-211 (New NH52) ; in the state of Maharashtra under NHDP Phase IV-B on EPC Mode.

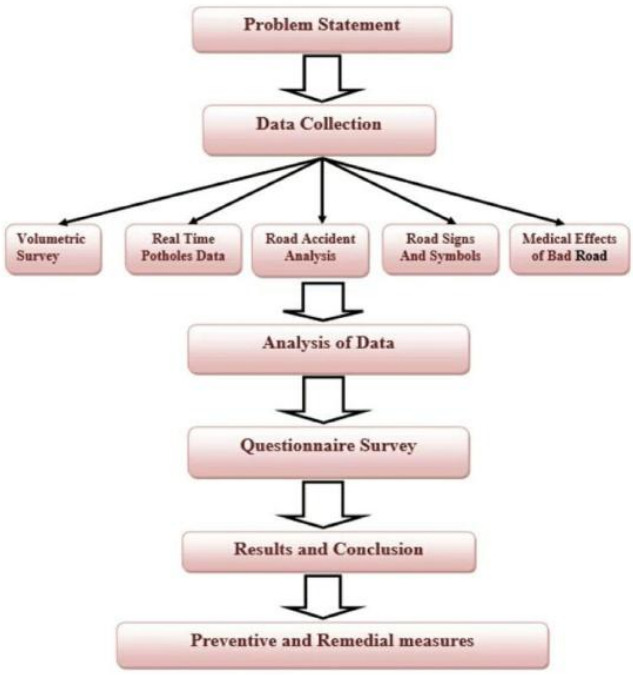
- The Audit comments on each of the road safety issues with safety recommendations to minimize the problems.
- Checklist is useful to assist the audit team. These checklist describe the performance and situations that can affect the road safety of selected types of projects and audit stage.
- Road safety Audit checklists ar presented in **IRC:SP:88-2019 MANUAL ON ROAD SAFETY AUDIT.**

❖ The checklist are for use during an audit when; Assessing the documentation; in particular, when the project drawings are being examined.

❖ Inspecting the site. At this point, it is important to visualize how the project will fit into the existing features.

❖ Writing the audit report-to re check that the relevant issues have been addressed.

- This checklist can be used on existing roads, new roads, roadwork traffic schemes, rehabilitation works, etc.



V. DATA COLLECTION

- **Medical Effects Due to Bad Road Condition**

Road Traffic Accidents (RTA) has suggested an important public health issue. In India, RTA injuries, deaths, fatal injuries, body damages are increased. It is required to stop road accidents, which causes medical hazards to human body. There is need of strict implementation of on it to overtake on public health issue.

We gain the data related to injuries due to bad road condition and potholes from Civil Hospital, Dhanvantari Clinic, and Sadaphule Accident Hospital. By observing report given by them we get information about injuries. Due to bad road conditions, diseases like Cervical Spondylitis, Backache, Sciatica, injuries of knee, shoulder etc. was occurred.

- **Questionnaire Survey**

It is the method of collection of data by public in a structured form, either written or printed, consists of a formalized set of questions designed to collect information on some subject or subjects from one or more respondents.

After doing the questionnaire survey, we got bad replies from the poles, Public was upset on PWD and local authorities regarding repairing work and regular or required maintenance of road.

- **Road Signs and Symbols**

The various devices used to control, warm regulate and guide traffic called as traffic control devices.

In addition, road light are useful in guiding traffic during night. The traffic signs should be backed by law in order to make them useful and effective traffic signs have been divided into three categories according to Indian Motor Vehicle Act. These are;

1) Regulatory Signs,
2) Warning Signs,
3) Informatory Signs

The signs should be provided such that they could be seen and recognized by the road users easily and in time. The size, shape, color code and the symbols used and the symbols and the location signs should be as specified under each category. The reverse side of all sign's plates should be painted grey.

After surveying selected chainage of road during day and night time, there are no provision of safety signs, symbols, road markings, street lights, etc. Many accidents are occurred due to insufficiency of guidelines on the road. There is need of provisions of it on road.

- **Traffic Volume Study**

It is the survey of number of different vehicles crossing a section of road per unit time during selected period . Study is done at selected point called as count posts or traffic count stations. A complete traffic volume study includes the classification and types of vehicles moving on road which are left goint, straight going straight going or right going and class of traffic. This study of traffic volume helps to understand.

1. Hourly, daily, yearly and seasonal traffic volume variations.
2. Volume and direction of traffic.

- **Real Time Potholes Data Collection.**

A pothole is a structural defect in a road surface, caused by failure preliminary in asphalt pavement due to the availability of moisture content or water in the subsoil strata and traffic intensity over affected road area. Presence of water content weakens the supporting soil of road.

VI. LITREATURE REVIEW

The section literature review different methodologies taken in research work done by different researches. Some

1) **Road Safety Audit for Four land National Highways Dr. S.S. Jain, P.K. Singh, Dr. M. Parida.**
2) **Road Safety Audit: A case study on NH-65 Tummala Bharat Kumar, chukkapalli Jeswanth Chowdary.**

Most of the studies are based on methods of assessment of road accidents. Their study includes accident data as main element of the research. Generally, Road Safety Audit's methods improve the understanding of the safety performance of roads, they all require accident data. But there is a lack of data like pothole data collection of road cause the traumatic spinal injuries, bones injuries, etc. After studying various review paper, we have found that the main aim of road cause the traumatic spinal injuries, bones injuries, etc. After studying various review paper, we have found that the main aim of road various review paper, we have

found that the main aim of road safety audit is to assure that all new road schemes operate as safety as practicable.

A road safety audit is "a formal, systematic and detailed examination of a road project by an independent and qualified team of auditors that leads to a report of the potential safety concerns in projects." It is a formal examination because the audit follows a set process that leads to a formal reports which becomes a part of the record of the whole road project. It is a detailed examination requires time, knowledge, skill, judgement, depth and detail.

The main objective of road safety audit is to minimize the risk of crashes occurring on an existing road project and to minimize the severity of any crashes that do occur or are likely to occur.

- **Road Safety Audit for Four land National Highways**

(Dr. S.S. Jain, P.K. Singh, Dr. M. Parida)

In this study authors have aim to evaluate Road Safety Audit of Section of Four lane National Highway (NH) -58 and focused on evaluating the benefits of the proposed actions that have emanated from deficiencies through the audit process. The main objectives of the study are to develop a methodology for Road Safety Audit for Four Lane NH, to develop a model for identification of safety influencing parameters in minimizing risk of accidents, to identify the speed limit matching with the vehicles speed on existing road profile of the highway section.

Authors concluded that, due to newly constructed NH-58 the road standards have been raised suddenly. The road standards are permitting high speed, but prevailing traffic conditions are not conductive to such speed and it has been found that Road markings, condition of Shoulder, traffic volume, spot speed, median opening and carriageway condition were creating traffic hazards for fast moving traffic as it always occupied the innermost lane of Highway. Pedestrian guardrail should be provided all along the footpath of service road and at bus stops.

- **Road Safety Audit : A case study on NH-65**

Tummala Bharat Kumar,
Chukkapalli Jeswanth Chowdary

In this case study authors has analyses the NH-65 from the point of view of safety and geometric design aspects was performed and the NH-65 has maintained and operated by National Highways Authority of India. The main objectives of the study are to identify designing imperfections and recommended intersections, identification of accident – prone regions on the highway and to study the impact of roadway geometrics and traffic conditions on the highway.

Authors concluded that, by analyzing the information it is found that road markings, condition of shoulder, condition of carriageway and median opening are the factors for causing accidents on the NH-65 . It also observed that the moderately moving vehicular traffic as it generally occupies innermost lane of National Highway.

- **Road Safety Audit: A case study for Wardha Road in Nagpur City**

(Manish D. Katiyari, Prof. S.D. Ghodmare)

In this case study authors has analyses the Wardha road from Morris College square to Airport Intersection and the NH is maintained and operated by National Highways Authority of India (NHAI) under the Ministry of Road Transport and Highways. The study aims to identify deficiencies, developing mitigation strategies and calculating the crash rate of each intersection or length of road with the help of Microsoft Visual Studio minimizing the accident rate or crash rate in future.

- **Road Safety and Road Safety Audit in India: A Review**

(Abdul Rahoof, Bipin Kumar Singh)

Road Safety review is a formal methodology for autonomous appraisal of the accident potential and likely safety execution of a particular outline for a road or traffic plan-whether new development or a change to a current road.

Security audit can be connected to new roads or existing/build roads. On new roads or roads to be enhanced or assembled, the review will prompt recognizable proof of clumsy circumstances and on existing or as of now build roads, the review will recommend the fitting alleviation measures to lessen the like hood of mishaps.

The RAS essentially includes 3 stages.

- **Stage I – Audit Amid Configuration and arranging.**
- **Stage II – Audit amid construction**

- **Stage III – Audit after the finishing of the venture.**

Road safety review is an essential means for giving careful considerations to road safety amid the configuration of road plans. This unequivocal consideration ought to help everybody required in settling on choices with respect to changes to road based to survey the safety ramifications of the numerous decisions that emerge amid the outline procedure, and accordingly build the road safety familiarity with base organizers, powers.

- **Hyderabad to Yadagiri Gutta Road safety Audit and Accident Analysis**

(P. Gautam, Prof. K, Vijaya Lakshmi)

The National Highway No. 9 starts from the intersection point of NH-9 and NH-7 at Hyderabad. Project includes developing the existing 2 lane carriageway to 4 lane dual carriageway configuration including strengthening of existing 2 lane on BOT basis and defined as "Project Highway". The following engineering surveys and investigations shall be carried out for developing the project;

- Data formats
- Reconnaissance Survey
- Road Inventory
- Topographic Survey
- Terrain
- Rehabilitation, Improvement and Up-gradation

Pavement design is very critical component for the urban arterial highway and the requirement will be analyze in depth taking in to account relevant design parameters such as traffic projection design cumulative ESA (Equivalent Standard Axle), material characteristics and the climatic conditions.

- **Road Safety Audit: A Case Study Navsari to Chikhli National Highway 48**

(Krunal Baraiya, Prof. Nekzad Umrigar, Dr. L.B. Zala)

In this case study authors has analyses the section of NH-48 from Navasari to Chikhli which is under the Ministry of Road Transport and Highways. Authors have referred the Manual on Road Safety Audit and some literature. After referring literatures authors have got the idea about, verification of black spot, different statically model for road accidents, different techniques for reducing road accidents and road safety audit for various stretch in India. Identification of black spot location and gives suitable solutions to reduce the road accident at those locations.

VII. STUDY AREA

BACKGROUND

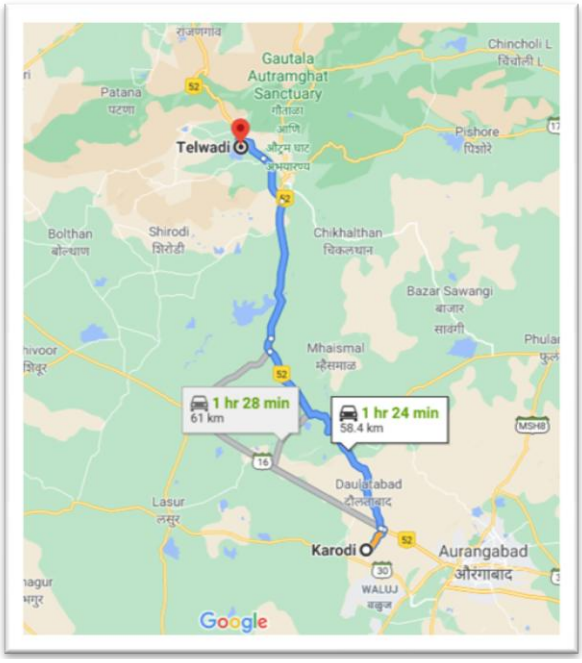
The **National Highways Authority of India (NHAl)** is engaged in development of National Highways entrusted to it by MoRT&H. As part of this endeavor, the Authority has taken up development of some of the highways through EPC mode, It is stipulated in the EPC Agreement that the Contractor shall appoint a Safety Consultant to carry out safety audit at the Design, Construction & Completion Stage of the project highway in accordance with the Applicable laws and Good Industry Practice. The Project Corridor i.e. "Four/Six Laning of Karodi (km.320.104) to Telwadi (375.000) road section of NH-211 (new NH No.52); (Existing Length 54.896 km; Design Length 55.610) in the state of Maharashtra under NHDP Phase IV-B on EPC Mode" is one such corridor identified by the Authority. M/s DILIP BUILDCON LIMITED has been selected as preferred bidder by Authority for the Project & called as "EPC Contractor". The Contractor M/s DILIP BUILDCON LIMJTED (EPC Contractor) has appointed Safety Consultants for "Four/Six Laning of Karodi (km 320.104) to Telwadi (km 375.000) road section of NH-211 (new NH No, 52); (Existing Length 54.896 krn; Design Length 55.610 km) in the state of Maharashtra under NHDP Phase IV-B on EPC Mode".

PROJECT AREA

The NH-211 starts from Solapur and ends at Dhule with total length of 453 km. At Dhule it meets with NH-3 (Mumbai-Agra) and NH-6 (Surat-Nagpur) whereas at Solapur it meets NH-13 (Solapur-Mangalore) and NH-9 (Pune-Machilipatnam).

LOCATION

The present project corridor is part of NH 211, with a length of 55.610 kms. The project corridor is shown in Fig.



APPROACH

Road Safety Audit is a formal examination of a road project or traffic project or any project which interacts with road users, in which an independent, qualified team reports on the project's accident potential and safety performance.

Road safety is a Multi - sectored and Multi – dimensional issue. It incorporates the development and management of road infrastructure, provisions for safer vehicles, legislations and law enforcements etc.

RSA is the process of evaluation of road schemes during design and construction to identify the potential safety hazards which may affect any type of road user, before the scheme is opened to traffic, and to suggest the measures to eliminate or mitigate those problems. The need for RSA is more for accident prevention (and in certain cases towards lessening the nature and quantum of punishment that could befall a user making an error).

In other words, RSA is not a way of rating a project as good or poor an dis not a check of compliance with available standards. The theme of RSA is in the ability to check a design for its fitness for purpose. Road Safety Audit is a formal procedure for assessing accident potential and safety performance in the provision of new road schemes, the improvement and the rehabilitation of existing roads in the maintenance of roads, it should form an integral part of highway planning, design, construction and maintenance, and it requires an objective approach to the assessment of accident risk,

The principal method of ensuring this objectively is through the independent assessment of schemes by persons who are independent of the original design team. The main aim is to ensure that all new highway schemes operate as safely as possible. This means that safety should be considered throughout the preparation and construction/maintenance of any project.

Stages of Auditing a Road Project

There are five stages of a road project at which a road safety audit can be conducted.

Stage I - Feasibility Stage/Preliminary Design Stage

An audit on completion of the planning or feasibility study stage will examine features such as design standards, rout choice and continuity with the existing adjacent network, horizontal and vertical alignments, cross sections and interchange/ intersection layouts.

Stage II - Detailed Design Stage

This audit stage occurs on completion of the detailed road design (the final DPR) but before the preparation of contract documents. Typical consideration include geometric layout, pavement markings, signals, lighting, road signs, intersection details, clearances to roadside objects and provisions for vulnerable road users.

Stage III - Construction Stage

This stage of audit takes place during construction of the road works. It examines the safety of the traffic management plans for each phase of construction for large
road projects and it also inspects the provision for road safety at the road work site during the construction period.

Project Road	Chainage (in Km)	Total (Km)
"Four/Six Laning of Karodi (km 320.640) to Telwadi (375.000) road section of NH-211 (new NH No. 52); (Existing Length 54.896 km; Design Length 55.610) in the state of Maharashtra under NHDP Phase IV -B on EPC Mode"	Km. 320.640 to Km.375.00	55.610

Stage IV – Pre- Opening Stage

This audit involves a detailed inspection of the new road project immediately prior to its opening. Although most road projects are constructed "under traffic" there is a time just before the contractor hands over the project when the project is almost complete and when a preopening stage audit is undertaken. The number of project stages at which audits are conducted usually varies according to the classification of the road and the size of the project.

Stage V – Safety Audit of Existing Roads

The existing road may be a well-established road dating back decades or it may be a recently upgraded or rehabilitated roads. The audit of existing road aims to ensure that the safety features of a road are compatible with the functional classifications of the road. It also aims to identify any feature that may develop over the time in to a safety issue.

A number of the safety issues found in this audit should be readily addressed through simple and low cost maintenance practices. As such, there are benefits in having maintenance crews trained in road safety reviews so that they can apply their safety knowledge routinely during each shift.

ROAD SAFETY AUDIT SURVEY

The EPC Contractor requested the Safety Consultant to conduct the Safety Audit for issues pertaining safety on project highway, for the Four/Six Laning of Karodi (km.320.104) to Telwadi (km.375.000) road section of NH-52 in the state of Maharashtra under NHDP Phase IV-B on EPC Mode.

<table>
<tr><td>ROB/ RUB</td><td>01 No.</td></tr>
<tr><td>Major Bridge</td><td>2 No's.
<table><tr><th>Sr. No.</th><th>Design. Chainage</th><th>Location</th></tr><tr><td>1</td><td>355+755</td><td>Shivna River (Tapargaon village)</td></tr><tr><td>2</td><td>370+345</td><td>Shivna River (Makranpur village)</td></tr></table></td></tr>
<tr><td>Flyovers</td><td>Nil.</td></tr>
<tr><td>Vehicular Underpasses</td><td>6 No's.
<table><tr><th>Sr. No.</th><th>Design. Chainage</th><th>Location</th></tr><tr><td>1</td><td>322+800</td><td>VUP on Railway Yard road (Village Talesaman)</td></tr><tr><td>2</td><td>324+390</td><td>VUP on SH 16 (Village Maliwada)</td></tr><tr><td>3</td><td>334+000</td><td>VUP at Kasabkheda Junction (Village Pachpirwadi)</td></tr><tr><td>4</td><td>341+480</td><td>VUP near Aurangabad Bypass end. (Village Verul)</td></tr><tr><td>5</td><td>364+030</td><td>VUP on Panpoi Road Junction (Village Banshendra)</td></tr><tr><td>6</td><td>368+869</td><td>VUP on proposed Kannad Bypass (Village Rail Navadi)</td></tr></table>.</td></tr>
<tr><td>Pedestrian / Cattle underpass</td><td>3 No's.</td></tr>
<tr><td>Bus Lay bye/ shelters</td><td>26 No's</td></tr>
<tr><td>Rest Areas</td><td>2 No's.</td></tr>
<tr><td>Truck Lay bye</td><td>2 No's.</td></tr>
<tr><td>Service/Slip Road</td><td>Approximately 16.956 km</td></tr>
</table>

Ghat / Hill section	Nil.
Toll Plaza	1 nos. (at Hatnoor Ch. 361+800)
Bypasses	3 Nos.

The audit team was accompanied on the visit by the EPC Contractor and Authority Engineer representatives. During the site visit the weather condition was cloudy and the road surface was wet.

The audit comprised of inspection throughout the project corridor and discussing various issues of safety aspects to EPC Contractor. The EPC contractor has informed that suggested work by safety consultant shall be completed / rectified on priority. However, it is suggested to follow safety measures applicable as per the codal provisions for the stretches wherever works are in progress during construction.

MAIN FUNCTIONS OF THE KEY PLAYERS IN ROAD SAFETY AUDIT

Key Player	Main Functions
Client, Project Owner (Govt. and/or Concessionaire)	• Expresses a commitment to road safety • Provides funding and resources for safety roads • Considers safety audits as essential • Commissions audits at appropriate times • Select road safety audit team • Facilitates the response to the recommendations of audits and arranges implementation of recommendations that are accepted and agreed • Attends commencement and completion meetings
Design Team	• Attends commencement and completion meetings • Provides relevant information to safety team • Acts upon and supports the client to provide response to recommendations of audit
Safety Audit Team	• Identifies safety issues in the proposed design • Inspect the site during day as well as night • Makes constructive recommendations to reduce risk ok crashes and their severity • Documents safety concerns and recommendations • Holds commencement and completion meetings with the client and design team

KEY STEPS IN A ROAD SAFETY AUDIT (As per IRC: SP: 88-2019)

1. Complying with the road safety audit policy of an organization, make a decision that the project is to be audited.
2. Appoint a safety audit team.
3. Handover all relevant information about the project to the Team Leader of RAS team.
4. It is necessary to hold a commencement meeting between the three key parties – Project Manager of the road authority, designers and the audit team to discuss the project and scope of audit.
5. Afterwards, the audit team begins the audit. The first part of its work is a "desktop" audit of the drawings and design reports.
6. The audit team then moves to the next part of the audit – a detailed inspection of the site during day time and night time. The team gathers by shooting chainage – wise photographs of all the problematic locations and records its observations. Further, the audit team is advised to recommended for applications of safe practices at similar such problematic locations in their RSA report.
7. Back in the office, the audit team prepares the audit report. When it is written, checked and signed it is submitted to Project Manager.
8. For large or sensitive projects, there may be a completion meeting in order for the stakeholders to discuss and clarify the key safety issues.
9. A paper trail is a required outcome from an audit and the Project Manager/ Road Authority is required to add this by responding to each audit recommendation – clearly stating what actions will or will not take place. Reasons for not accepting any recommendation shall be recorded.
10. Thereafter, implement all agreed changes and recommendations.

VIII. PROJECTS ARE TO BE ROAD SAFETY AUDITED

All new road projects will benefit from having road safety audits undertaken during the design and construction stages. However, in recognition of the need to apply resources to where they can have maximum effects, road safety audits may be commissioned only at selected stages according to the cost of the road project or the classification of the road.

THE BENEFITS OF AUDITS

The established benefits of conducting road safety audits include;

- Reduced "whole of life cycle costs" of a road project
- Reduced risk of crashes and its severity while using the road network.
- Enhanced attention to the safety needs of vulnerable road users
- Lower costs for remedial work at black spots.
- Reduced overall costs of road trauma to the community

IX. CONCLUSION AND RECOMMENDATIONS

General :

Based on the present study of Road Safety Audit of **Four/Six Laning of Karodi (km.320.104) to Telwadi (375.000) road section of NH-211 (new NH No.52); in the state of Maharashtra under NHDP Phase IV-B on EPC Mode** the following conclusion have been drawn:

Road studs, road delineators are not found as per IRC: SP: 84. It is Ensure that the road studs are provided as per IRC: SP: 84 to improve night time visibility. Roadway indicators and Delineators are pending at some locations and it is highly recommended to provide delineators with reflective sheet as per IRC: 79 and IRC: SP: 84.

Proper safety precautions are not followed by the site workers. It is highly recommended that the workers are taking all safety precautions on site during construction. EPC Contractor shall provide the Ambulance as per specifications in IRC:SP:84 clause 12.9, 12.9(a), 12.9 (b).

The Sign boards should be provided as per IRC:67. Ensure that all junctions are developed as per IRC: SP: 84 with proper Road marking as per IRC:35, Sign Boards as per IRC:67 and Traffic Calming measures as per IRC :99. Unauthorized median openings need to be closed at ch. 321+760, 325+320, 329+780, 340+940, 370+100, 373+210. EPC Contractor shall provide the patrolling vehicle as per the specifications. EPC Contractor shall ensure that all the encroachments and advertising boards on Median and within ROW have to be removed immediately. Provide emergency call boxes and its signs.

REFERENCES

[1]. IRC:SP:88-2019,**"MANUAL ON ROAD SAFETY AUDIT"**
[2]. Chetan Joshi, Kunal Shirsath, Akash Chavan, Prakash Lonkar,
[3]. "Advanced methodologies for accident reduction at un-signalized intersections".
[4]. Jian Lu, Li Yuan, Guoqiang Zhang, and Qiaojun Xiang "Safety evaluation and improvements for highway intersections".
[5]. Shengxue Zhu, Jian Lu, and Gu Wang "Intersection safety evaluation model".
[6]. Bruce Corben, Jennifer Oxley, Sjaanie Koppel and Ian Johnston, "Cost effective measures to improve crash and injury risk at rural intersections".
[7]. Li Yuan, Jian Lu "Safety Evaluation Method of Roadway Intersections".
[8]. Federal Highway Administration, "Low cost intersction safety improvements", U.S. Department of Transportation, Washington, D.C.,2008
[9]. P.K. Sikdar and J.N.Bhavsa "Road safety scenario in India and proposed action plan" "Transport and communication Bulletin for Asia and the pacific" NO.79,2009.
[10]. Dr. S.S. Jain, P. K. Singh, Dr. M Parida "Road Safety Audit for Four Lane National Highway".