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A Case Study of Road Safety Audit of Mahamaya Flyover to Greater Noida Expressway

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ABSTRACT: Road safety is a huge problem in develop and developing countries, road safety measures are not implemented seriously yet, especially in developing countries. 1.35 million (2016) people are killed each year on the world's roads, and that this figure has plateaued since 2007. For every 1 person who dies in a road traffic crash, 20 are injured. Road safety measures are important to be defined and implement before, during, and after road accident occur. Furthermore, evaluation is needed after implementation of road safety measures, in order to find out whether safer road is better or not. The aim of this study is to develop road safety measurement based on existing road condition, traffic condition, accident happened, before and after implementation of road safety measures. Road safety value by indicators as the results should be implemented consistently and hard effort of all stakeholders should be done to provide safer road. Results of this study are important to reduce number and severity of casualties and moreover lead to safer road. Post construction. The purpose of the audit is to identify road safety problems and to suggest measures to eliminate or mitigate any concerns. Road Safety Audits are undertaken by self or road safety engineering. The purpose of the evaluation will be to determine whether the objectives of the process have been achieved and to make an assessment of the quantifiable benefits which flow from the audit process.

This report is based on the findings of the safety aspect for Noida - Greater Noida Expressway. The research showcases the problems arising on Noida - Greater Noida Expressway and Public is facing lives Risk by travelling through it. The Audit will be conducting following the guidelines of, IRC: 67-2012, IRC: 35-1997, IRC: SP: 88, IRC: 99-2018. Correction of Road signs, markings, message signs, hazard markers, traffic safety barriers, identification of black spots, delineators had done based on the requirements. This report work for Safe and forgiving roads. We argue that significant measures need to take on Road Safety aspects to mitigate the accidents and ensure the safety to vehicular traffic.

KEYWORDS: Road safety audit; safety measures; Forgiving roads; Traffic.

I. INTRODUCTION

Road safety audit is a systematic and formal process of checking the safety aspects of road schemes before they are built. The objective is to identify potential safety problems, so that, where possible, the design can be changed to eliminate or reduce them. The audit is carried out by trained and experienced auditors who are independent of the scheme designers. Road safety auditing follows the principle of "prevention is better than cure". An audit conducted at the planning or design stage allows a line on a plan to be changed, which is much cheaper than having to alter asphalt or concrete once the scheme has been built. Most countries have experience of having to make major alterations to a newly-built road because a significant safety problem was designed into the road. This can be avoided if all schemes are audited before construction. Experience from other countries suggests that at least a third of crashes can be prevented or their severity reduced by conducting road safety audits and acting on the findings. In today's 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 crores of people. In India itself about eighty thousand people are killed in road crashes every year which is thirteen percent of the total fatality all over the world. Man behind the wheel plays an important role in most of the crashes. In most of the cases crashes occurs 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. A road safety audit assesses the safety of all road users including car drivers and passengers, pedestrians, bicyclists and motorcyclists, trucks, bus passengers and 3 wheelers and users of animal drawn vehicles. Our aim is to provide road safety information for road users to encourage safer road user behaviour among current and prospective road users and reduce the number of people killed and injured on our roads every year.

II. LITERATURE REVIEW

Kristina Baklanova, Evgeny Voevodina, Elena Cheban, Andrey Askhabov and Artem Kashura (2020) this paper used road safety audit methodology, an accident analysis was carried out and emergency-dangerous sections of the Federal highway R-255 were identified. The sliding window method was used to determine the road sections with a high rate of accidents. The road safety audit allows us to analyse the factors of road conditions and the road schemes and simulate real accidents using the PC-Crash program for reconstruction of road accidents. Based on these data, it is possible to take the best measures to eliminate the road sections with a high rate of accidents. [1].

Jayaprakash M C, (2019) The paper is presented to Road Safety Audit (RSA) is a formal procedure for assessing accident potential and safety performance of new and existing roads. RSA is an efficient, cost effective and proactive approach to improve safety of the road users with leading to any trend of accidents and their impacts. RSA appears to be an ideal tool for improving road safety in India, as basic and accurate data on accidents have yet to be collected in a scientific way as well as in a systematic method. It is evident from the traffic composition for the countries like India, where heterogeneous traffic with varying vehicle types differing in their vehicle static and dynamic characteristics. The project stretch considered is NH-69 (Bhadhravathi to Shivamogga –Karnataka State) ranging 22.1 Kms. The present study deals with road inventory, signage inventory, traffic volume count survey, spot speed study, Speed and delay study and other surveys such as topographic survey and Accident data has been collected for the stretch for a period of 2012-16 is collected and analysis is carried out. The study aims to evaluate Road Safety Audit of a section of four-lane National Highway (NH)-69 and will focus on evaluating the benefits of the proposed actions that have emanated from deficiencies identified through the audit process. Missing road and median markings to be done and speed signs should match with speed. Access and service lanes are also deficient which requires immediate improvement. [2]

Shwetank.R.Saagar, Prof. Shivam Chaturvedi (2019) In this paper studied Road Safety Audit (RSA) is a formal examination of proposed or existing roads and road related areas from the perspective of all road users with the intention of identifying road safety deficiencies and areas of risk that could lead to road crashes. Road Safety Audit (RSA) is formal and independent safety performance review of a road transportation projects by an experienced team of safety specialists, addressing the safety of all road users. Road Safety Audit helps in reducing the number and severity of crashes. It also helps reduce costs by identifying safety issues and correcting them before projects are built. This State Highway 27 originates from Jhalawar (Rajasthan) passes through Ujjain (Madhya Pradesh) and ends at Malkapur Maharashtra and covers the length of 387 km approx. The State Highway-27 was two –lane highway but with the requirement of time it was converted into Six-lane Highway. The section which comes under the research is Indore-Ujjain Highway from Luvkush Square to Shri Vaishnav VidhyapeethVishwavidhyalaya Indore, Madhya Pradesh. This national highway is maintained and operated by National Highway Authority of India (NHAI) and Madhya Pradesh Road Development Corporation (MPRDC). The identification of the critical section has been taken place on it. The study will be identifying the defects of the roads and will give the better idea about the defects .In this study the crashes reduction factor and crash modification factor will be found to know the actual condition of the section. [3]

Sudipa Chatterjee Partha Sarathi Bandyopadhyaya Sudeshna Mitra (2019) The paper presented to identify the critical safety issues observed during RSA on the two major two-lane undivided highways in the state of West Bengal, India. Both the highway carries a considerable amount of traffic and passes through numerous built-up areas, markets and industrial belts. Several risk factors were identified at different hazardous locations along the highway stretches during the RSA. Lack of infrastructure, interaction of vulnerable road users (VRU) with high-speed traffic, and faulty geometric design are some of the most alarming safety deficiencies identified through the audit process. The insights obtained from the RSA report could not have been gained from the accident reports alone. [4]

III. STUDY AREA AND METHODOLOGY

Site Location and Salient features of Project

Noida-Greater Noida Bundh Expressway (NGNBE): nearly 25 km long, INR 400 crore, 6-lane expressway between Yamuna river and existing Noida-Greater Noida Expressway will run over the flood prevention embankment from Noida Sector-94 (near Okhla bird sanctuary) to Noida Sector-168. Near sector 94, it will start from the existing Noida-Greater Noida Expressway, then along the way near Gulavali & sector 160 will interchange with Gulavali-LG Chowk road, and end near sector 168 at Faridabad–Noida–Ghaziabad Expressway.

The expressway is 24.53 km (15.24 mi) long, built at a cost of ₹400 Crore to relieve the old Delhi-Agra national highway (NH-2) which was already congested and ran through the heart of cities like Faridabad, Ballabhgarh and Palwal.

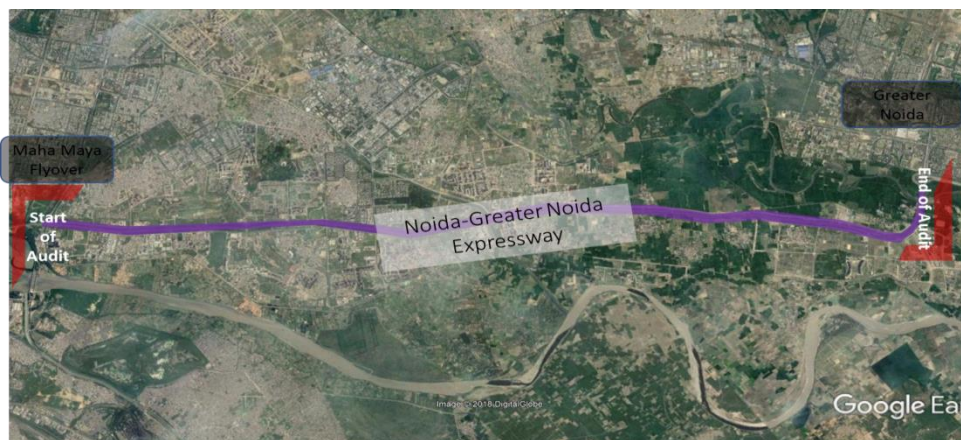


Fig 01: Start and End of Project Section

IRC:67	Code of Practice for Road signs
IRC :35	Code of Practice for Road Markings
IRC :53	Road Accident Forms
IRC :54	Clearance for Vehicular Underpass
IRC :62	Guidelines for control of Access on Highways
IRC:69	Space standards for roads in urban areas
IRC:103	Guidelines for Pedestrian Facilities
IRC:79	Recommended Practice for Road Delineators
IRC:73	Geometric Design standards for rural highways(non-urban)
IRC:38	Guidelines for Design of Horizontal curves for highways and Design Tables
IRC:SP-88	Manual on Road Safety Audit
IRC:SP-99	Guidelines for safety in construction zones
IRC:SP-23	Vertical curves for highways
IRC:SP-15	Ribbon Development along highways and its prevention
IRC:SP-41	Guidelines on design of at grade intersections in Rural and Urban areas.
IRC :119	Guidelines for Traffic Safety Barriers

Checklists for carrying out road safety audit for different stages of the project

These checklists describe the problems and situations that can affect the road safety of selected types of project and audit stage.

The checklists for different stages of audit are presented hereunder:



- Checklist 1 - Stage 3 Audit
- Checklist 2 - Stage 4 Audit
- Checklist 3 - Stage 5 Audit
- Checklist 4 - Road Signs
- Checklist 5 - Road Markings
- Checklist 6 - Roadside Hazards

Traffic Control devices

- Road Signs
- Road Markings
- Road Studs
- Road Lighting

Risk Assessment of Safety concerns and Prioritization of suggested recommendations

Risk is often defined as the likelihood (frequency) of an event time the consequence (severity) of that event. Table below gives simple criteria for the risk involved in the safety concerns assessed by the safety auditor. It is a qualitative assessment process and it requires professional judgment of the Auditor.

Severity	Description	Examples
Very High	Multiple Deaths are likely	High speed, multi-vehicle crashes on expressways. A bus collision at high speed with a bridge abutment.
High	A death and/or serious injuries are likely	High/medium speed collisions with a fixed roadside object. Pedestrian crashes on rural highways
Medium	Minor injuries only are likely	Low speed collisions, such as a three-wheeler colliding with a bicyclist, a rear end crash in a slip lane, or a pedestrian struck in a car park.

Severity	Suggested Treatment Approach
Essential	Where risk is assessed as Very High, the recommendation shall be implemented "at any cost" .
Highly Desirable	Where risk is assessed as High, the recommendation shall be implemented unless cost of remedial treatment is prohibitive and risk can be reduced by an alternative measure.
Desirable	Where risk is assessed as Medium, the recommendation shall be implemented if the safety concerns could not be mitigated even after the implementation of the recommendations under "essential;" and 'highly desirable' priority levels for the same location and the risk needs to be reduced further

IV. ROAD SAFETY AUDIT OPERATION & MAINTENANCE STAGE

General

As mentioned above, RSA is a formal procedure for assessing accident potential and safety performance in the provision of new road schemes, the improvement and rehabilitation of existing roads and in the maintenance of roads. Road Safety Audit is specifically intended for Operation and Maintenance Stage of the project stretch as observed in 2022. This RSA is primarily based upon guidelines presented in “IRC SP: 88-2019 - Manual on Road Safety Audit” and some related international practices for O&M stage safety audit. This report reviews the safety measures adopted by the Contractor while construction and it reports potential hazards due to the noncompliance of safety norms (if any), provisions for pedestrian safety, effective numbers of reflective signs, safe delineation, credible speed limits, crash



barriers, lighting & diversions etc. Note that the report's primary intent is to advise Concessionaire about what measures to be needed to improve road safety for all road users. The recommendations / improvements suggested herein are based on the philosophy of averting road accidents due to erroneous judgment of the drivers and to protect the vulnerable road users from getting involved in collisions. The implementation of the recommendations entirely remains in the contractor's scope of work.

Objective and Scope of work

The main objective of this report is to find out road safety performance of Expressway as mentioned above. Various safety concerns were observed during the site visits and recommendations as per provisions of IRCs have been provided in order to ensure the safe movement of all road users on this corridor. Drawings have not been reviewed. Road safety deficiencies and behavioural safety issues are identified, and accordingly countermeasures are recommended. The objective of the exercise focuses on minimizing road accidents and their severity with the improved Level of Service (LOS). The objectives of audit are as below:

- To minimize the risk and severity of crashes
- Minimize the risk of crashes occurring on adjacent roads.
- Recognize the importance of safety in road design
- Reduce the long-term costs; unsafe designs are difficult and expensive to correct later.
- Improve the awareness of safe road engineering principles
- Advance the awareness of providing safe road schemes for non-motorized as well as motorized road users

Report Structure

The findings of the report are presented in the following form. Each situation under these categories will be presented in the following formats:

- Observation : Problem Observed
Reasons for Concern : The safety concerns have been mentioned supported with pictures extracted from the drawings to support the gravity of issue
Recommendations : The Audit recommends road safety engineering measures for the observed problem.

Audit Details

Date of Opening	9 Aug 2012
Date and Day:	19/11/2022 – Saturday
Time:	Started around 09:30 pm; Night audit time: 6:45 PM
Weather:	Clear Sky, Cool Temperature

V. DISCUSSION AND RESULT

Findings from Safety Audit for the Entire Study Corridor

Towards assessing the safety related issues in an objective manner, we had visited the project road and carried out Operation & Maintenance stage audit with the help of an objectively drafted check list. The Road Safety Manual is a good guide towards ensuring safety in operation and maintenance of road. But application of the measures sometimes lack clarity on ground. These were the areas of pointed attention during this stage. That is also where additional safety measures are often called for. These apply equally to roads and road structures.

The Audit carried out a comprehensive operational stage safety audit, during November and December 2022, the findings from the same have been documented in this report. While all the IRC guidelines and the various Circulars from the MORT&H have in built safety considerations, the following guidelines/codes of practices were considered for more in depth review (latest editions).

Route Safety Audits and Findings

- Missing of Informatory sign boards.
- Parked vehicle on edge of a carriageway near washroom facility.
- Gantry column, KM stone, Stairs of FOB and other obstructions are observed on shoulder.

- End treatments of Metal beam crash barrier at termination and connection between RCC are improper at almost all locations.
- Non-IRC standard lane direction informatory sign on gantry is observed at all locations.
- Aesthetic decoration and structure provided may cause distraction of road user.

VI. SUMMARY AND CONCLUSION

Conclusion in general issues pertaining to existing highways are summarized as under

1. Signage's: Signage's are not installed at proper location and of proper dimension and colour should be as per provisions of IRC: 67-2022.
2. Road Markings: At certain locations pavement marking and merging/diverging roads has not been marked as per codal guidelines. This should be ensured as per provision of IRC: 35-2015.
3. Crash Barrier: Location/Placement/Height of crash barrier is deficient at many locations also termination of crash barrier is non standard, which should be insured as per provisions of IRC: 119-2015.
4. Advertisement & Aesthetic Provision: In some road stretches and on Bridge advertisements and aesthetic structure, drawings have been displayed which is distracting attention of driver which may cause a serious hazard. All hoardings and display of advertisement should be relocated as per provision contained in IRC: 46-1972.
5. Poor Pavement Surface:
 - In some stretches carriageway has cracks and initial sign of failure which should be maintained so as to achieve require roughness parameter.
 - Due to poor maintenance of shoulder at certain locations edge drop has been observed between bituminous and hard shoulder portion. This should be maintained properly so as to avoid risk of any accident.
6. Beautification at the cost of Safety: At certain locations plantation pots have been placed in front of crash barrier in clear zone area. It should be removed and clear zone should remain unobstructed.
7. Drainage: In some locations drain/chute drain was not cleaned which may lead to obstruction of storm water. It should be cleaned in order to avoid any stagnation of storm water causing damage to pavement surface.
8. Public Facilities: Public facilities like Toilet Blocks, Washroom, and Rest area should needed routine maintenance. There should be proper entry and exit with sufficient taper length and information board before the entry location. These facilities should not have direct access to the main carriageway.

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