

# Road Safety Audit of Existing National Highway-44 in the City of Delhi

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**Abstract**— Road transport has become an important part of every human being in today's world. Although the present transportation system has minimized the travel distances, it has increased the life risks on the other hand. Road traffic accidents and crashes causes serious life injuries and results in loss of lakhs of lives in the world. Every year, nearly 1.5 lakh people are killed in road accidents in India. India ranks first among the 199 countries in terms of road accident fatalities, accounting for nearly 11% of all accident-related deaths worldwide. A Road Safety Audit (RSA) is an independent audit team's systematic safety performance review of a current or potential road or intersection. In this study, road safety audit of an existing highway section of National Highway-44 (old NH-2) for about 12.5 kms in the city of Delhi was conducted by videography recording and walkthrough at certain locations as appropriate for both traffic directions. Various safety issues and deficiencies were observed, noted and recorded in the study and suggestive recommendations were proposed for improving the safety performance of the existing highway stretch in consideration.

**Keywords**—Road Transport; Road Traffic Accidents; Road Safety Audit

## I. INTRODUCTION

A structured, systematic, and thorough review of a road project by a qualified and trained team of auditors that results in a summary of the project's possible safety issues is known as Road Safety Audit (RSA). It is a structured investigation since the audit follows a set procedure that culminates in a formal report that becomes part of the project's record. It's a thorough investigation that takes time, experience, expertise, judgement, depth, and attention to detail. A road safety audit results in a road safety audit report that identifies road safety problems and makes recommendations to eliminate or reduce their effects.

A road safety audit evaluates the safety of all road users, including pedestrians, bicyclists, and motorcyclists, trucks, bus riders, 3-wheelers, and animal-drawn vehicles. It is a systematic procedure (not just an informal check) undertaken by individuals who are independent of the design, conducted by persons with sufficient qualification, training and experience, an evaluation of road safety problems in a road design, a Traffic Management Plan for road works, a newly completed road scheme, or it may be the identification of safety concerns on any existing road. Road Safety Audit can be conducted during Pre-construction phase, Construction Phase & Post-construction Phase of any project.

The present study deals with Road Safety Audit of an existing highway passing through urban area. The study area

includes the urban portion of National Highway-44 (Old National Highway-2) from India Gate (Junction of Zakir Hussain Marg & Subramaniam Bharti Marg) to Badarpur border excluding 0.5km of Ashram Chowk underpass portion due to ongoing construction activity, which is widely referred to as the Delhi-Mathura highway and spans approximately 12.5 kilometers. The highway is a 4 to 6 lane carriageway with 3.5m wide traffic lane having flexible pavement and varying width of median. The project highway consists of 2 nos. Flyovers, 1 no. Rail Overbridge, 4 nos. Foot Overbridge, 1 nos. Roundabout intersection and 11 nos. Signalized Intersection. The findings of Road Safety Audit done for the project stretch are reported in this paper.

## II. LITERATURE REVIEW

Sphere Infratech [1] has performed Road Safety Audit of existing highway section of State Highway-07 from Modhera to Chanasma in the state of Gujarat, India and suggested mitigative actions for improvement of existing highway safety. Sophia Vardaki, Fanis Papadimitriou & Pantelis Kopelias [2] has performed Road Safety Audit on Attica Freeway in Greece which is a 70 km freeway and is used as a ring road for Athens, the capital city of Greece. Based on the data collected and field investigations, recommendations were made for improvement of the freeway. Sphere Infratech [3] has performed Road Safety Audit of State Highway-130 (Pre-opening stage) from Shihori to Visnagar in the state of Gujarat, India and suggested preventive measures for improvement of highway safety prior to its opening. Daksheshkumar [4] attempted to analyze the traffic safety situation of Kapurai-Dabhoi section of SH-11, Gujarat, India and to identify countermeasures for stretches in which the total harm caused by crashes can be substantially and readily reduced. D. G. Patel, F. S. Umrigar, C. B. Mishra, and A. A. Vankar [5] studied the Road safety audit of selected stretch from Umreth junction to Vasad junction i.e., SH-83 and SH-188 which are one of the major state highways in the state of Gujarat, India and identified the blackspots and suggested remedial measures.

## III. METHODOLOGY AND OBJECTIVES

The existing highway project section of National Highway-44 starts near India Gate and ends near Badarpur border having total length of 12.5 kms excluding 0.5km of Ashram Chowk underpass portion due to ongoing construction activity. Fig.1 shows the location map of study section.

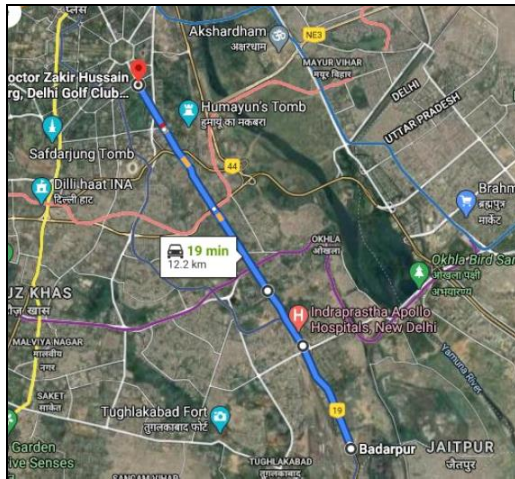


Fig 1. Location Map of Project Highway



Fig 2. Start Point of Project stretch of NH-44 near India Gate (Junction of Zakir Hussain Marg & Subramaniam Bharti Marg)



Fig 3. End Point of Project stretch of NH-44 near Badarpur Border

#### A. Methodology of Research

Due to considerable length of national highway, the present study was restricted to section starting from India Gate (Junction of Zakir Hussain Marg & Subramaniam Bharti Marg) to Badarpur Border, which is widely referred to as the Delhi-Mathura highway and spans approximately 12.5 kilometers. The Road Safety Audit was conducted for both directions since it is a four to six-lane divided carriageway. Since the data such as traffic volumes, highway drawings (alignment plan and profile, structure, signage & marking drawings, etc.), previous road safety audit reports were not available for the project stretch, the present study was based on moving car videography recorded in the daytime during site visit in April, 2021 and walkthrough carried out as appropriate for certain locations. The videography for the project stretch was carried out in such a way that the existing highway features that needs to be looked upon for improvement and safety can be highlighted in the audit report.

#### B. Objectives of Research

The primary objective of the study is to conduct the safety audit of an existing highway in order to reduce the severity of accident crashes and minimize the risks of accidents to the road users. The adequacy of the highway, roadside features, intersections and side roads, grade separators, bus stops, vulnerable road user needs, access management, etc. were the important considerations. It will ensure that a road's safety features are consistent with the road's functional classification.

### IV. ROAD SAFETY AUDIT

Fig. 2 and Fig.3 shows the start and end points of existing project highway section of NH-44 in consideration.

#### A. Road Safety Audit Checklist for Existing Highway

The road safety audit checklist addresses the safety needs of vulnerable road users such as pedestrians, bicyclists, rickshaw pullers and three-wheelers in the same way that motorized road users' (car, truck and bus users) safety needs are considered. Checklists are designed to reduce the possibility of critical safety issues being ignored during an audit. Checklists can be developed based on phases of a project such as Planning/Feasibility, Detailed Design, Construction, Pre-opening and Existing roads.

Since the scope of thesis was related to Road Safety Audit of an existing national highway, the checklist for audit of existing roads as per Indian Roads Congress Special Publication:88-2019 Manual is used. Table I shows the checklist adopted for conducting Road Safety Audit of project stretch.

TABLE I. CHECKLIST FOR SAFETY AUDIT OF EXISTING ROADS

Sr. No.	Issue	Yes	No	NA	Comments
1	<b>Sight Distances</b>				
	Are all sight distances satisfactory for the speed of traffic using this road?				
	Are safe overtaking opportunities provided?				
	Are U-turn provisions conspicuous and "safe"?				
2	<b>Intersections</b>				
	Are all intersections clear and visible?				
	Are all traffic signals conspicuous, functioning properly and safely?				

Sr. No.	Issue	Yes	No	NA	Comments
	Are roundabouts visible and recognizable from all approaches?				
<b>3</b>	<b>Interchanges</b>				
	Are sight lines open and free of obstruction at all merging and diverging areas?				
	Are the distances between decision-making points adequate for safety at the operating speed?				
	Is the direction sign for each interchange clear and easily understood at the operating speed?				
<b>4</b>	<b>Cross-sections</b>				
	Are lane widths, shoulder widths and bridge widths, "safe" for the traffic volume and mix?				
	Are medians and islands of adequate width for the safety of likely users?				
	Are the shoulders suitable for use by all vehicles and road users, including pedestrians, cyclists and animals?				
	Is appropriate super elevation and extra width of carriageway provided on curves?				
<b>5</b>	<b>Roadside Hazards</b>				
	Are all larger (more than 100mm diameter) sign supports located outside the clear zone if they are not frangible?				
	Are all crash barriers correctly and safely installed?				
	Are any hazards within the approved clear zone width for this road?				
	Are crash barriers used only where necessary?				
	Are impact attenuators provided in gore areas?				
	Are all the crash barriers correctly installed?				
<b>6</b>	<b>Drainage</b>				
	Is the road well drained?				
	Are all drains outside the clear zone, covered, or behind suitable barrier?				
<b>7</b>	<b>Signs, Pavement Markings and Delineation</b>				
	Do all signs and pavement markings satisfy the 6C's of good signage and pavement marking practice?				
	Is the speed zone "safe" and clearly signed?				
	Are pavement markings conspicuous and continuous?				
	Are road signs and road markings tested for retro-reflectivity and conforming to relevant standards?				

Sr. No.	Issue	Yes	No	NA	Comments
	Is the road well delineated (warning signs, plastic guideposts, chevron alignment markers) installed as necessary and spaced in accordance with installation guidelines?				
	Is there a need for more signs to warn, inform, guide, control or delineate?				
<b>8</b>	<b>Vulnerable Road Users (pedestrians, bicyclists, two wheelers and three wheelers, animal drawn carts)</b>				
	Do all vulnerable road users have connectivity along the road, with suitable lateral clearance to motor traffic?				
	Are pedestrians able to safely walk along the road?				
	Is the road free of "squeeze" points where vulnerable road users are exposed to nearby moving traffic?				
	Are pedestrians able to safely cross the road?				
	Are dropped kerbs provided at all intersections and mid-block locations where pedestrians are to cross?				
	Is the number and placement of the pedestrian facilities adequate and safe for the situation and the pedestrian numbers?				
	Are all the formal crossings clearly marked and conspicuous on each approach?				
	Are the correct signs and pavement markings installed at each pedestrian facility?				
	Is each crossing facility well illuminated at night so that pedestrians can be seen by drivers/riders?				
	Do all mid-block traffic signals have pedestrian push buttons?				
	Are pedestrian paths provided through medians to permit to cross "at-grade" and to assist disabled pedestrians?				
	Has adequate provision been made for safe parking and stopping by three-wheelers/cycle rickshaws?				
	Does the road allow adequate visibility for an approaching driver to see a pedestrian waiting to cross the road?				
	Does the road allow adequate visibility funnel for an approaching driver to see a vehicle waiting to cross the carriageway from side road or storage space of median?				
	Are bus stops located where passengers will use them?				
	Are bus stops well delineated and lit?				



Sr. No.	Issue	Yes	No	NA	Comments
9	<b>Access to Property and Developments?</b>				
	Are all accesses to/from adjoining properties "safe"?				
10	<b>Lighting and Night time issues</b>				
	Are the illumination levels of an appropriate standard, consistent with the needs of the location, pedestrian and other factors?				
	Are the lighting columns frangible? If not, are they located outside the clear zone?				
	Are all signs easy to see and read at night?				
	Are the critical locations (intersections, pedestrian facilities, bus bays, bus stops, truck lay bye, toll plaza, etc.) conspicuous at night?				
	Is lighting provided on road sections passing through built-up areas, service roads, above and below the grade separator, underpass, etc.?				
	Is the "through route" well signed, line marked and obvious to road users at night?				
	Is the road free of visual deceit for road users at night?				
	Is all lighting adequate and safe?				
	Are there any lighting poles in the median (less than 2m wide) unprotected by crash barriers?				
11	<b>General Road Safety Recommendations</b>				
	Is the road as safe as practical given the local weather conditions?				
	Is the road surface free of gravel and sand, and with good skid resistance?				

Yes – Likely to be satisfactory for safety, No – Possible Safety issues, N/A – Not applicable

### B. Road Safety Audit of NH-44

Based on the points specified in the checklist above and videography survey conducted along the project stretch for both the traffic directions, various safety issues were highlighted in audit findings and appropriate recommendations were suggested for improvement of safety performance of the highway and for minimizing the risk of accident crashes. The risks related to identified safety issues and the priority level assignment for the suggested recommendations were also proposed based on the guidelines given in IRC SP:88-2019 manual.

### V. SUMMARY AND CONCLUSION

The Road Safety Audit of NH-44 detected several issues related to sight distance, road signs, pavement markings, vulnerable road user needs, intersections, road side hazards, footpaths, medians, pedestrian guard rails, parking facilities, etc.

### A. Conclusions

Following conclusions were drawn on the basis of Road Safety Audit conducted on the project highway.

- No segregation of traffic existed along the project highway
- Facilities for pedestrians and other vulnerable road users were not as per prescribed standards
- Presence of hazardous objects such as trees, portable concrete crash barriers, broken kerbs and footpath, etc.
- Poor conditions of road signs and pavement markings.
- Visibility obstructions to various shoulder mounted road signs and gantry signs
- Non-standard road signs were used at many locations
- Road signs and markings missing at important locations such as intersections, sharp horizontal curves, service road entry and exit ramps, median openings, etc.
- Road markings missing at many locations
- Retro-reflective raised pavement markers and traffic impact attenuators missing along the highway
- Poor condition of metal beam crash barriers
- Broken and damaged pedestrian guard rails at many locations
- Inadequate visibility at intersections
- Excessive growth and inadequate maintenance of trees and shrubs

### B. Recommendations

Suitable remedial measures were recommended to improve the safety performance of the existing highway stretch in consideration some of which are listed below.

- Segregation of through traffic and slow-moving traffic due to urban land-use
- Periodic/Routine maintenance of Road signs and markings
- Provision of road signs as per the prescribed standards
- Provision of adequate infrastructure and facilities for non-motorized traffic
- Provision of speed limit signs at regular intervals
- Provision of Retro-reflective raised pavement markers at horizontal curves, intersections, grade separators, median openings, etc.
- Provision of Traffic Impact Attenuators at hazardous approaches to service road exit ramps
- Provision of Transverse bar markings at approaches to hazardous reaches for speed reduction and warning
- Proper monitoring of road user behavior and characteristics e.g. driving speed, wrong-side driving, use of seat belt and helmets, etc.
- Repair, replacement and maintenance of existing pedestrian facilities such as footpath, railing, kerb ramps, safety bollards, median refuge, etc.
- Provision of adequate road signs and markings at intersections and median openings
- Regular trimming and removal of trees and shrubs in median and footpath
- Provision of required sight distances at intersections
- Parking provision facilities for vehicles
- Removal of roadside encroachments on footpath

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