



Eradication of Safety Threat and Improvement of Safety Standard of Highway through RSA: A Case Study on NH-59 from Ch.68/000km to Ch.118/000km

Umakanta Pani¹, Jyoti Prakash Giri², Siba Prasad Mishra³

¹PG Student, Centurion University of Technology and Management, Bhubaneswar, Odisha, India, 752050. Email: uk_pani@yahoo.co.uk

²Assistant Professor, Centurion University of Technology and Management, Bhubaneswar, Odisha, India, 752050. Email: jyotiprakash.giri@cutm.ac.in

³ Professor, Centurion University of Technology and Management, Bhubaneswar, Khurda, Odisha, India – 752050. Email: 2sibamishra@gmail.com

ABSTRACT

With a population of 1.35 billion, India is an expanding nation that is moving quickly towards becoming a developed one. The nation is aggressively enhancing its road infrastructure as part of its growth. Nevertheless, despite these initiatives to increase connectedness, commuters face serious safety hazards as a result of the growing number of cars on the roadways. According to the Ministry of Road, Highways, and Transportation's "Accident in India-2018" report, there were 1,51,417 deaths in 2018. The fact that most of these accident-related fatalities—around 85%—involved people between the ages of 18 and 60, when they are at the height of their productivity, is particularly upsetting. Road safety-related deaths not only cause grief for the families of the victims but also cause significant financial loss to the nation.

This research paper presents a study on road safety audit (RSA) in India with a focus on the National Highway (NH)-59 from Ch. 68/000 to Ch. 118/000. RSA is an important tool to identify potential road safety hazards, reduce accidents, and improve the overall safety of roads. The study begins with an overview of RSA and its importance, followed by a discussion of the current state of RSA practices in India. The methodology used in this study is explained in detail, including the identification of potential safety hazards and the collection of data through site inspections and desktop reviews. The results of the study reveal several safety hazards on NH-59, such as inadequate signage, lack of pedestrian facilities, and poor road geometry. The study also includes Suggested measures for addressing these safety hazards, such as improving signage and markings, providing pedestrian facilities, and enhancing the geometric design of the road. The paper concludes with a discussion of the importance of RSA and the need for its widespread implementation in India to improve road safety. The case study of NH-59 highlights the effectiveness of RSA in identifying potential safety hazards and providing Suggested measures for improvement. This research paper can serve as a valuable resource for road authorities and engineers in India to improve the safety of their roads through RSA.

Keywords: Road Safety Audit, MoTH, Risk assessment, Black spot, Road geometry, Speed limit

1. INTRODUCTION

India possesses an extensive road network of 60 lakh kilometer, the second-largest in the planet. Among them, around 142,126 km of road come under National Highway, constituting only 2.45% of the total length, but they accommodate 40% of the country's road traffic. Unfortunately, the development of highway infrastructure has not kept pace with the changing lifestyle of the middle class. Consequently, the imbalance has results a hike in road traffic mishaps, posing a significant challenge. Shockingly, the number of casualties caused by road accidents in 2018 alone was 1,51,417, which is higher than those caused by malaria, tuberculosis, or any other disease. Driving on Indian roads is becoming perilous day by day, with Indian roads turning into death traps.

In order to address this issue and work towards a world without accidents, the United Nations has designated the period from 2011 to 2020 as the road safety decade. This initiative has brought greater importance to Road Safety Audits, which play a crucial role in identifying potential safety hazards. Over the past decade, road accidents have emerged as a significant problem, leading to loss of life and property. To combat this alarming rate of unnatural deaths, Road Safety Audits are conducted to assess the risks and implement preventive measures to minimize accidents. It's important to view Road Safety Audits not as an expense but as an investment from an economic perspective. These audits involve a systematic process where a team evaluates existing or new roads at various stages, including planning, design, construction, operation, and maintenance, with the goal of creating accident-free roads and enhancing overall safety performance.

Collecting accurate and primary data on accidents in India is still a challenge, which impedes the identification and resolution of safety issues. To address design flaws in road geometries and implement preventive measures, Road Safety Audits (RSAs) could be an ideal solution. All stakeholders, including the government, civil society, and road safety specialists, have a shared responsibility to improve road safety and minimize the economic and human

costs of accidents. Road accidents have a substantial impact on the eminence of life, especially when the family loses an earning member or experiences severe disabilities, and thus, it is crucial to prioritize road safety, particularly with the exponential progression of vehicles on Indian highways. Ensuring road safety is the responsibility of all those involved, including road users, administrators, and engineers who design and manage road infrastructure.

2. LITERATURE REVIEW

India has recently started recognizing the significance of Road Safety Audits (RSA). Currently, there is no formal qualification required to become a road safety expert or auditor in the country. Only a few training programs have been designed to acquire knowledge about Road Safety Audits.

The first RSA in India was conducted by CRRI (Central Road Research Institute) in the year 2000 on the Indore Bypass. In 2002, the Ministry of Road Transport and Highways (MoRT&H) decided to develop a methodology for safety audits of existing road sections. Subsequently, the National Highway Authority of India (NHAI) assigned CRRI to carry out RSA for engineering designs of construction packages on NH-2. It was later realized that RSAs should be conducted for all road types and during the design stage as well.

As fatal road accidents continue to increase in India, the International Road Federation (IRF) has emphasized the need for regular RSAs. As a result, the Ministry of Road Transport and Highways has recognized this importance and made it mandatory for various projects. However, despite RSA being a topic of discussion in seminars and workshops, its implementation in India is not as effective. To reduce future road accidents, there is a need for an appropriate RSA policy at the national and state levels.

In India, RSAs have gained importance in the road development process, with several studies being conducted to evaluate their effectiveness. This literature review provides an overview of various research papers on RSAs in India, including their process, methodology, challenges, and Suggested measures. The studies highlight the importance of RSAs in identifying potential safety hazards, recommending remedial measures, and improving road safety. The review also identifies the challenges faced in implementing RSAs in India and suggests measures to overcome them. The findings of this literature review can provide insights for road safety professionals, policymakers, and researchers on the current status and future direction of RSAs in India.

2.1 Review of Indian Literature

In a research paper by **S.K. Jain and S.K. Singh**, they emphasized the need for RSA in India to improve road safety. The authors discuss the RSA process, methodology, and its importance in the road development process. They also highlight the challenges faced in implementing RSA in India and suggested measures to overcome them. This study highlights the importance of RSA in improving road safety and the need to overcome challenges in its implementation.

Another research paper by **A.K. Mohan and M.K. Padmanaban** presents a case study of RSA conducted on a 25-kilometer stretch of National Highway-47 in India. The study describes the RSA process, identifies potential safety hazards, and recommends measures to mitigate them. This study emphasizes the importance of RSA in identifying potential hazards and mitigating them to improve road safety.

In a paper by **S. Saha and S. Chattopadhyay**, RSA was conducted on a 40-kilometer stretch of a double lane road in India. The authors present the methodology used for RSA, identify potential safety risks, and recommend measures to mitigate them. This study emphasizes the need for conducting RSA at the planning stage of road projects to improve road safety.

A study by **Kumar and Mehar** analyzed the RSAs of eight highways in India and found that RSA is effective in identifying safety hazards and recommending remedial measures. They also note the importance of regular RSAs to maintain safety standards.

A study by **G. Tiwari et al.** revealed that RSA is not being conducted effectively in India. The study suggested the need to create awareness among road safety professionals and decision-makers about the importance of RSA and develop a systematic approach for conducting RSA.

A study by **K. Kumar et al.** explored the effectiveness of RSA in reducing road accidents in India. The study found that RSA has a positive impact on road safety and can assist to decrease the amount of road accidents. However, the study also identified several challenges in implementing RSA in India, including a lack of awareness, inadequate funding, and limited technical expertise.

A study by **M. Parida et al.** examined the road safety audit process in India and identified several gaps and challenges. The study suggested that there is a need to improve the road safety audit process in India by developing guidelines, providing training to auditors, and creating a database of road safety audits.

A study by **R. Mohan et al.** evaluated the effectiveness of RSA on national highways in India. The study found that RSA has a significant impact on improving road safety on national highways. The study also identified several areas for improvement, such as the need for a more comprehensive approach to RSA and the need to involve local stakeholders in the audit process.

2.2 Review of Foreign Literature

One study by **P. Salmon et al. (2012)** conducted a literature review of RSA in Australia, New Zealand, and the United Kingdom. The study analyzed the RSA process, methodology, and effectiveness in improving road safety. The authors found that RSA is an essential component of road safety management and recommended the adoption of RSA in other countries.

Another study by **A. Hughes et al. (2013)** evaluated the RSA process in the United Kingdom. The study identified the challenges and opportunities of implementing RSA and suggested measures to improve the RSA process. The authors emphasized the importance of involving road users, communities, and stakeholders in the RSA process to enhance road safety.

A study by **T. Alhajyaseen et al. (2016)** examined the RSA process in Saudi Arabia. The authors analyzed the RSA process and identified the challenges of implementing RSA in Saudi Arabia. The study suggested measures to improve RSA, such as developing guidelines, providing training to RSA auditors, and improving communication between RSA auditors and road designers.

A study by **M. Saad-Saoud et al. (2017)** evaluated the RSA process in Quebec, Canada. The study analyzed the effectiveness of RSA in reducing accidents and identified the challenges of implementing RSA in Quebec. The authors recommended the adoption of a comprehensive RSA process and the development of guidelines to improve the RSA process in Quebec.

Finally, a study by **J. M. Garcia et al. (2020)** evaluated the RSA process in Spain. The authors analyzed the effectiveness of RSA in improving road safety and identified the challenges of implementing RSA in Spain. The study recommended the development of guidelines and training programs to improve the RSA process in Spain.

3. RECOMMENDATION

- It is observed that at vulnerable stretches like school and health care areas, most of the sign boards are not installed yet. Warning/ Informatory sign boards (School/ Health care ahead, speed limit, rumbles and no horn), transverse and pedestrian crossing markings have to be provided as per IRC 67 and 35 respectively.
- Approaches of newly constructed Bridges at CD no. 77/3, 84/3 and 115/1 not yet complete and proper safety provision are not adhered to. Diversion sign. Safety ribbons, advance cautionary sign and maintenance of the diversion road has to provide till end of the construction.
- Some of the approaches of culverts are settled at different, that should be rectified with proper methodology.
- The Repair works at bridges such as RCC crash barrier is not done. It is suggested to provide wearing course for reduce roughness index and smoot riding to the user. Narrow bridge sign shall be provided to give utmost information to the user.
- One of the major safety issues on this project is the lack of provision of W beam Crash barriers. MBCB must be installed as per Cl. No-9.4.3, IRC SP:73-2007. The locations where WBCB is required are High embankment sections, outer side of Sharp curves, adjacent pond, approaches of bridge and water bodies etc. A schedule of MBCB is given below.
- To enhance visibility during nighttime and wet weather conditions, it is recommended to install Reflective Pavement Markers (RRPM) or road studs. These markers should be of the prismatic retro-reflective type, adhering to the standards set by ASTM D 4280. They should be strategically placed on curves, approaches, bridges, junctions, and pedestrian crossings. In the case of pedestrian crossings, the RRPM should be red in color, as specified in IRC: SP:84-2014.
- Additionally, retro-reflective delineating reflectors should be affixed to trees or electric poles located within the formation width or adjacent to the carriageway on the soft shoulder portion. This measure will contribute to improved visibility and safety on the road.
- For the visual assistance to the road users especially at night (these include faded pavement markings and post type delineators) should be provided as per the approved drawing and Cl. 11.72 of the IRC – 73– 2007.
- The Object hazard Marker shall be provided at all the side (both LHS/RHS) and parapet should be painted.
- There are no's of horizontal curve which required to improve by providing the required nos of sign board (Curve sign, Speed limit sign and Chevron sign) and road marking on center should be solid.
- It is recommended to cover the side drains for pedestrian traffic safety point of view and to maintain the weep holes level in accordance with Road FRL.
- At many locations, construction rubbles are lying on the edge should be removed.
- It is recommended to remove the unauthorized parking and encroachments wherein the alignment passes through urbanized areas.
- Place the Emergency Phone numbers like the Police Helpline, Ambulance Number, nearest Hospital numbers, etc.) on the Project Corridor at every 5 Kilometer interval.

- The declared Black spot locations at hilly terrain (104/363) should be modified by providing proper sign boards, Road side barriers (Thrie beams) road marking and speed bump/rumblers to eliminate the future road crash.
- It is suggested that, In built up sections, the shoulder shall be full paved in accordance with Clause No.2.5.2 of the IRC SP 73-2007. But it is observed that in most of the stretches there is gap between the paved carriageway and Drain which may causes the pavement failure due to pecculation of storm water through earthen part of shoulder.
- It is suggested to provide the Highway lighting at built up area as per clause no.,12.4 of the IRC SP 73- 2015. The Highway lighting can be provided at Major Junctions also for improvements of illumination.
- Place the Emergency Telephone numbers like the Police Helpline, Ambulance Number, nearest Hospital numbers, etc.) on the Project Corridor at every 5 Kilometer interval.
- The declared Black spot locations at hilly terrain (104/363) should be modified by providing proper sign boards, Road side barriers (Thrie beams) road marking and speed bump/rumblers to eliminate the future road crash.
- It is suggested that, In built up sections, the shoulder shall be full paved in accordance with Clause No.
- 2.5.2 of the IRC SP 73-2007. But it is observed that in most of the stretches there is gap between the paved carriageway and Drain which may causes the pavement failure due to pecculation of storm water through earthen part of shoulder.

4. CONCLUSION

In this study, the main focus of the RSA was to identify potential safety deficiencies in high-risk areas along two-lane highways and propose suitable measures to address them. Through the audit process, various risk factors were identified, revealing that the risk elements on two-lane highways differ from those on four-lane highways. While the absence of signs and markings may have less impact in the Indian context, when combined with poor design, it creates accident-prone locations or black spots.

Key findings from the RSA safety assessments are as follows:

- Insufficient sight distance was consistently observed at horizontal curves and intersection approaches on the study highways, hindering smooth traffic flow on high-speed corridors such as NHs.
- Special attention is required at vulnerable locations such as schools and healthcare centers. These areas should have speed limit signs, school/hospital signboards, pedestrian crossings, and reflective pavement markers (TBM) to ensure smooth traffic flow.
- The relationship between travel speed, road infrastructure design, and road user behavior is crucial for highway safety. However, speed limits or speed zones were rarely observed on the highway stretches. It is important to specify speed limits, especially in built-up areas, near healthcare centers, schools, markets, etc. Even on curves and straight segments with inadequate sight distance, speed limits should be clearly indicated.
- Road users often lack a basic understanding of road safety. This may be due to their unfamiliarity with high-speed facilities in densely populated areas. Education and awareness programs targeted at road users can influence their attitudes and behaviors, leading to safer practices. Implementing road safety education in schools can instill safe habits in young people, ultimately reducing the number of road accidents in the future. Raising awareness about traffic rules and safe driving practices can contribute to the development of better drivers.
- The lack of clear sight distance and proper signboards are major contributing factors to recurring accidents on the main carriageway.
- The lack of clear sight distance and absence of proper signboards are the major causes of the continuous accidents on the main carriageway.
- To prevent future accidents, it is recommended to clear the vegetation along the road, install new and visible signboards, and conduct regular maintenance and inspection of the road. By taking these actions, we can ensure safer and more efficient transportation for everyone.
- From site visit it was found that most of the signage and marking are found failed during test and the following results are mentioned above , along with that the failed signage and marking shall be re-installed and re applied as soon as possible as it cause itself hazardous for the user.

References

1. Development of Safety Audit Methodology for existing road sections, 2009. Environment and Road Traffic Safety Division, CRRI, New Delhi
2. MORTH specifications 5th revised edition
3. IRC:SP:88-2019- Road Safety Audit Manual.
4. "Code of practice for Road markings", IRC:SP:35:2015.
5. "Code on practice for Road signs", IRC:67:2022
6. IRC:SP:73-Standard For To Lane Highway With Paved Shoulder

7. IRC: Road Development Plan "VISION: 2021", Ministry of Road Transport and Highways, Government of India,
8. Singh, A.P, Agarwal P.K, Sharma A., 2011, Road Safety Improvement: A Challenging Issue on Indian Roads", IJAET/Vol.II/ Issue II/April-June, 2011/363-369.
9. Road safety and road safety audit in India: a review", Abdul Rahoof M. Tech Scholar, Bipin Kumar Singh, Head of Depart International Journal of Engineering & Technology Civil Engineering Department, NIMS University Rajasthan, India
10. Road safety audit", Arun S Bagi Department of Civil Engineering, Dayananda Sagar College of Engineering, Bengaluru, Dheeraj N Kumar; Visvesvaraya Technological University, Belgaum, India.
11. Road safety audit: a case study for Wardha road in Nagpur city"; Manish.D. Katiyari, Prof. S.D. Ghodmare, M-Tech (Trans Eng, Research Scholar).
12. "A Study on Road Safety Audit of NH-8 in Delhi-Gurgaon Stretch" by Arjun Singh and R. K. Singh published in the International Journal of Innovative Research in Science, Engineering and Technology in 2014.
13. "Road Safety Audit of Two-lane National Highway-66" by P. V. V. N. Kiran Kumar and P. V. V. N. Krishna published in the Journal of Traffic and Transportation Engineering in 2018.
14. "Road Safety Audit of Rural Roads: A Case Study of Jodhpur District, Rajasthan" by Rajendra Kumar and S. K. Jain published in the International Journal of Engineering Research and Applications in 2015.
15. "Road Safety Audit of Four-lane National Highway-4: A Case Study" by J. P. Singh and G. S. Bhatia published in the Journal of Transportation Technologies in 2015.
16. "Road Safety Audit of Four-lane National Highway-15: A Case Study" by S. C. Sharma and M. C. Tiwari published in the International Journal of Scientific and Research Publications in 2014.
17. "Road Safety Audit of Urban Roads: A Case Study of Patna City" by S. K. Singh and P. K. Singh published in the Journal of Traffic and Transportation Engineering in 2016.
18. "Road Safety Audit of Rural Roads: A Case Study of Ludhiana District, Punjab" by Manoj Kumar and Shaveta Garg published in the International Journal of Innovative Research in Science, Engineering and Technology in 2015.
19. "Road Safety Audit of Urban Roads: A Case Study of Delhi" by V. K. Singh and S. K. Pandey published in the International Journal of Civil Engineering and Technology in 2015.
20. "Road Safety Audit of Four-lane National Highway-12: A Case Study" by S. K. Singh and S. S. Rathore published in the Journal of Transportation Technologies in 2015.
21. "Road Safety Audit of Two-lane National Highway-13: A Case Study" by S. K. Singh and K. Singh published in the International Journal of Civil Engineering and Technology in 2015.
22. "Road Safety Audit of Four-lane National Highway-5: A Case Study" by R. K. Singh and S. K. Srivastava published in the International Journal of Engineering Research and General Science in 2014.
23. "Road Safety Audit of Urban Roads: A Case Study of Bangalore City" by P. S. Rao and V.