



“ROAD SAFETY AUDIT AND SAFETY MANAGEMENT AN COMPLEMENTARY APPROACH AIMED AT IMPROVING ROAD SAFETY THROUGH THE IDENTIFICATION, ASSESSMENT, AND MITIGATION OF RISKS” A CASE STUDY FROM BHOR TO MAHAD 47KM

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Abstract

This article delves into the intricate relationship between highway traffic safety and economic growth, particularly focusing on India and other transitional economies. It uncovers a noteworthy finding that the correlation between these two factors doesn't always translate into enhanced traffic safety. In these nations, the surge in motorization, indicated by the increase in automobile density, often occurs without corresponding efforts to mitigate the accident rate effectively.

Among the key contributors to improving highway safety are effective traffic infrastructure planning strategies. These strategies involve reshaping traffic patterns within city centers and creating ample pedestrian and isolated bike lanes to segregate them from vehicular traffic. Additionally, aligning safety objectives with physical infrastructure development plays a pivotal role. This entails ensuring that transportation infrastructure projects are not only constructed but are also accompanied by measures to decrease the proportion of private cars on the roads while simultaneously increasing the usage of public transportation options. This coordinated approach is crucial for fostering safer highways amidst the burgeoning motorization rates seen in transitional economies like India

Keywords:

countermeasures, vulnerable road users, road safety audit, Hidden Black spot, Safety management

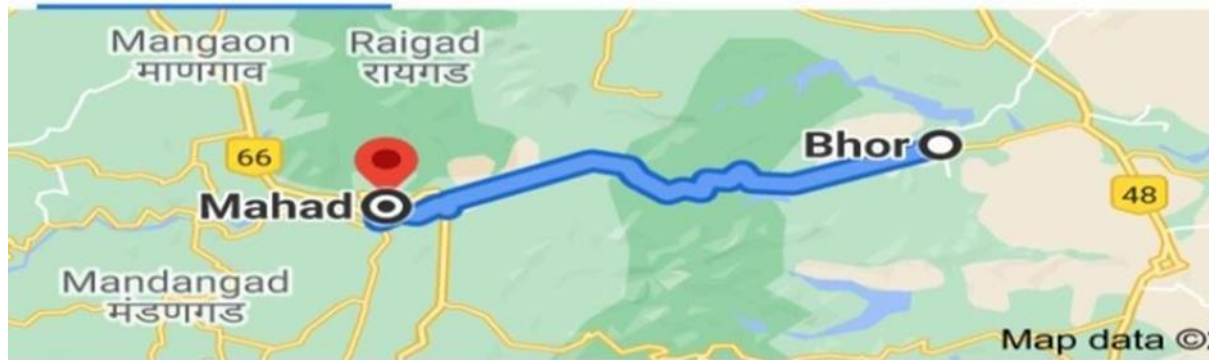
1. Introduction

Indeed, the term "highway" historically referred to a public road designated for the passage of various travellers, including vehicles, bicycles, and pedestrians. Interestingly, the term "highwaymen" was used to describe robbers who targeted these travellers on such roads. When we talk about highway engineering, we're discussing a specialized discipline within civil engineering. It encompasses the planning, design, construction, and maintenance of public roads, including highways. Highway engineers are tasked with creating roadways that are safe, efficient, and sustainable, considering factors such as traffic flow, terrain, environmental impact, and safety standards. Roads are one of the most cost-effective and commonly utilized modes of transportation, accessible and available to the entire community. It makes it easier for you to move construction materials and labour throughout the nation. It facilitates national integration and offers opportunities for both economic and national growth. It is a crucial piece of infrastructure that connects to other transportation options like rail, air travel, and so on. Therefore, to support trade and commerce and meet the needs of a reliable transportation system globally, an effective and sustainable road network is essential. Highway networks are necessary for the movement of people and goods throughout the world, as should be noted. It is significant to remember that transportation of people and things makes highway networks possible everywhere in the world. It is significant to remember that transportation of people and things makes highway networks possible everywhere in the world. After the wheel was invented, a man became the first carrier on the roadway, followed by a camel, a donkey, a horse, and numerous more wheeled vehicles. Even thousands or even hundreds of years before our time, man was already familiar with the process of designing highways. Congestion, funding, administration, building, maintenance, and other highway engineering challenges were addressed and handled by those who came before us

in their own unique ways to meet their needs. a multidisciplinary, unbiased panel evaluating the legal performance of current and upcoming road safety or intersections. It correctly evaluates and documents possible problems with road safety and finds ways to make all road users' safety better. A road is a path or road that connects two or more locations and is used for the movement and transportation of people, products, etc. using two- and four-wheeled vehicles like bicycles and motorbikes. An equal plan for the Indian Road Development Plan, known as the "Nagpur Road Plan" by the Indian Road Congress (IRC), was prepared in 1943 during a conference of the Central Engineers of the Central and Provincial Government of India, Nagpur, given by the central government.

1.1. Site Selection for Study

Indian National Highway 965DD, is a national highway. It is an alternate route leading off of National Highway 65 Operating in Maharashtra State is NH-965DD. Two-lane NH965DD (47 km from Bhore to Mahad) Bhore is situated in India in latitude 730'84'20" E and longitude 180' 14'58" N. Mahad is situated in India at latitude 730'42'24" E and longitude 180'0'80" N. Linear Distance: 28.1 miles, or 45 Kms and 200 meters. 1 hour and 24 minutes is the travel time. Bearing and direction: 260° WEST



1.2 Objective

- ❖ Decrease the amount of preventive action required after the road project is operational
- ❖ Detect high-risk regions for highways.
- ❖ Examine how traffic patterns and road shape affect this particular route.
- ❖ Increasing knowledge of road engineering safety management concepts.

2. Literature Review

[1] Abhishek Durga and Yogesh Kumar Road Safety Audit and Comparison with Accident Case Studies Indian Journal of Science and Technology, Vol 12(22), June 2019. The accident data for past 4 years 2015 – 2018 was considered and compared the RSA data with various identified accident case studies in that stretch After conducting RSA, it was found that the effective width of carriageway was reduced by the trucks, which were parked on highway, and creating traffic hindrance to high speed moving vehicles. Numbers of street lights are not sufficient and most of the Street lights are not working properly throughout the stretch. Median openings were found at unauthorized places which should be immediately closed, Access and service lanes are also deficient which requires immediate improvement. Growth of uncontrolled vegetation on either side of the road should be removed. Road and median markings which are found missing should be corrected and speed signs should be indicated at various places. This study will be more useful if the RSA data would be updated, and the reason behind each accident, are recorded and corrective measures taken.

[2] Anandraj and S. Vijayabaskaran Evaluation of Road Safety Audit on Existing Highway by Empirical Babkov's Method Saudi Journal of Civil Engineering Saudi J Civ Eng, 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 road safety. It is



proved that RSA has the potential to save lives. 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. The study aims to evaluate Road Safety Audit of a section of four - lane Madurai - Chennai, National Highway (NH) - 45 and will focus on evaluating the benefits of the proposed actions that have emanated from deficiencies identified through the audit process. After conducting RSA, it is found that trucks are parked on highway which reduces the effective width of carriageway and creating traffic hazards to high speed moving traffics. Unauthorized median openings were found which should be immediately closed. Missing road and median markings to be done and speed signs should match with speed. Access and service lanes are also in deficit which requires immediate improvement. The most Vulnerable Road User (VRU) i.e. pedestrians and cyclists facilities near habitations are lacking and needs to be facilitated on priority.

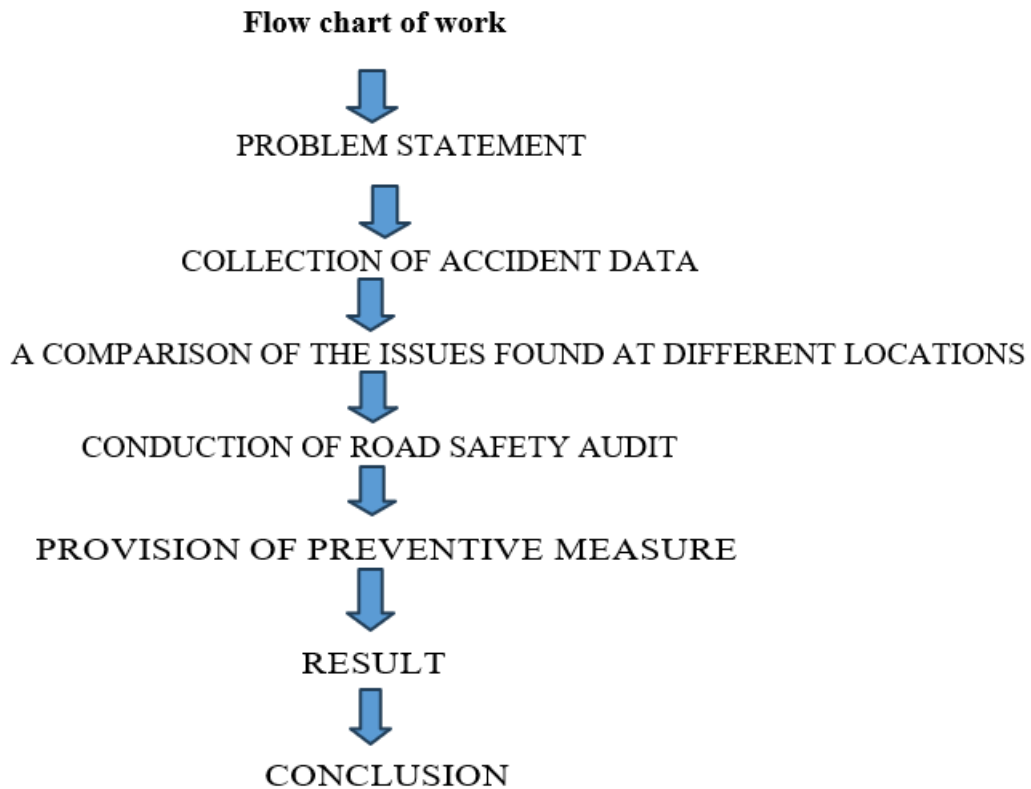
[3] Ankur Goyal and Mukesh Choudhry Accident Analysis and Blackspot Identification of Hulasur Basavakalyana Road- Karnataka In India Nearly 53 accidents happen in every 1 hour. These accidents also affect the economy of the country. In developing countries accident rates are higher compared to a developed country. For accessing the performances of road there comes a concept of Road safety audit (RSA). Road safety audit (RSA) is engineering approach to reduce the accident rates and to protect the road user. Using RSA, one can identify/assess the blackspots and hazardous locations and providing treatment/measures based on site constraints. It is also a cost-effective process. In this report a case study was conducted for an existing state highway considering recent trends of accident. The study aims to find out the safety problems for Indian roads and providing remedial and mitigating measures to reduce the road accident in India.

[4] Arun S Bagi and Dheeraj N kumar "Road Safety Audit" IOSR Journal of Mechanical and Civil Engineering. The objective of the study is the identification of accident prone areas on the road from FIR, to study the effect of roadway geometrics and traffic conditions on the road stretch and development of statistical relationship between accident rates and various factors causing accidents. The scope of the study is to reduce accidents on road network, reducing severity of accidents and the need for costly remedial work is reduced. The road selected for the study is Bannerghatta road (12 km). The accident analysis is done from four years data. The V.F.Babkov's analysis is done by collecting geometric features of the road. Pedestrian safety analysis also done. Accident prone locations are identified by the all analysis.

[6] Hafeez and komal Accidents black spots on highways and their low-cost remedial measures Urban Transport The main objective of this study is to highlight importance of accident record keeping, analysis of facts, identify accidents black spots and to provide suitable low cost remedial measures. How existing available accident data can be analyzed and processed in order to address the main causes of the crashes with respect to vehicle, road characteristics at specific locations and road user's psychology in Pakistan. How each and every black spot can be treated independently based on its nature, size and intensity of accidents. This can be done in a systematic way so that a better, safer and convenient road traffic system can be developed

[7] Hitesh kumar and Monika Research Paper on the Road Safety Audit and a Case Study on Kaithal-Kurukshetra Road Haryana, India International Journal of All Research Education and Scientific Methods In this study, the section of road from A.T.E.S. Faculty of Polytechnic, Akole to M/S. R. V. Traders Godown, Shekaiwadi (K.G.Road SH 44) is undertaken. Road taken having considerable traffic during day time and some black spots on the road where accidents takes place continuously. A detailed analysis of road from Agasti College, Akole to M/S R.V. Traders, Akole is carried out on the basis of data collection like traffic volume study, accidental data collection, potholes on road data collection, road safety signs and symbols, questionnaire survey of public, etc. The aim of study is the inspecting the road in the terms of the safety measures, road scenario, any type of flaws and to suggest the mitigative and preventive measures for the selected section of road for audit.

3. Methodology



3.1 Problem Statement:

The main issue with this road is landslides, particularly during the rainy season, yet it was chosen since it is shorter, has stunning scenery, and has enhanced transportation and development in distant areas. As a result of heavy rain, we found landslides, damaged road surfaces, and disturbance in contact in multiple sites. Thus, selected these route with the intention of minimizing unintentional incidents and managing safety measures along the way.

3.2 Data Collection:

Accident data was acquired from the appropriate police department's Bhore office, as the project is located in Pune District, Maharashtra. Data was collected across five years, from January 2019 to December 2023. At each accident site, the following criteria are recorded: date, time, location, type of accident, division of accident, Cause, road traffic, intersection details, responsible vehicle, and the value of impacted persons. This information is utilized for additional risk assessments. The design tunnel saw 79 accidents during a five year period (Jan2019 to December 2023).

Accident Raw data summary is given below in table and chart format:

Table -1: Cumulative Data of 05 years (2019- 2023)

SR. NO	ACCIDENT LOCATION IN KM	LOCATION	NO. OF ACCIDENT IN LAST 5 YEAR
1	0 To 10	Vadgaon Dal to Ambeghar	16
2	10 To 20	Ambeghar To Nigudaghar	18
3	20 To 30	Nigudaghar To Hirdoshi	11
4	30 to 47	Hirdoshi To Varandha ghat	34

SR. NO	DESCRIPTION	2019	2020	2021	2022	2023
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1	TOTAL NO. OF ACCIDENT	21	18	18	6	20
2	FATAL ACCIDENT	3	2	1	0	2
3	GRIEVOUS	6	8	5	2	7
4	MINOR	7	5	6	3	7
5	NON-INJURED	4	2	5	1	3

Table -1.1: Cumulative Data of 05 years (2019- 2023) Nature of Accident

Table -1.2: Cumulative Data of 05 years (2019- 2023) Location of Accident



Sr. No	Risk Element	Risk factors	Proposed Countermeasures
1	 <p>Horizontal Curves</p>	1)Limited viewing Distance. 2)Vehicles overtaking on blind corners 3)Inadequate super Elevation.	Use flexible pole barriers to separate opposing direction traffic from areas Of dispute. 2. Rumble strips placed in the center and edge lines to inform and Caution cars 3. Warning signs and delineation should be provided
2	 <p>Intersection</p>	1. Limited visibility from minor routes 2. Driving under the influence and excessive speed	1. There should be warning signs and delineation. 2. When feasible, channelize vehicle movements 3. Use speed bumps to slow Down on the minor road before Joining. 4. Flaring the corners will Improve turning maneuverability. Signage and road markings must be installed.

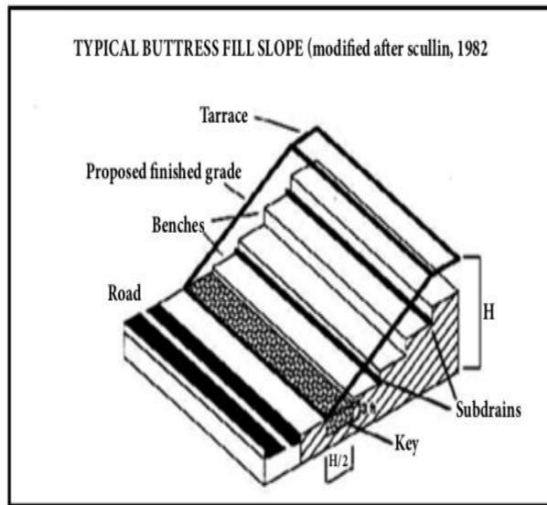
Table -1.3: Types of Risk Elements

4. Conclusion

Recommendations for Countermeasures

1.Benching:

As the reduce slope's height, horizontal benches can be excavated into a slope to provide the best protection against steep slope failure. Horizontal benches can help stabilize the slope by redistributing the gravitational forces and reducing the potential for mass movement



2. Creating Support for Overhang:

Sandbags can be used as a substitute for appropriate, sturdy material while building a wall or scaling an overhanging rock.

3. Retaining Wall:

By preventing the material from moving laterally, retaining walls sustain the sloped Material. The design of a retaining wall is influenced by various factors, including soil properties such as bearing capacity. Soil bearing capacity refers to the maximum load that the soil can support without undergoing excessive settlement or failure. It's a critical parameter in retaining wall design as it determines the size, shape, and reinforcement requirements of the wall



4. Constructed Gabion wall

Gabion walls offer several advantages, including their flexibility, permeability, and environmental sustainability. They can adapt to ground movement and settlement, allow for natural drainage, and blend well with the surrounding landscape



5. Rock bolting technique

The technique used in geotechnical engineering and mining to stabilize rock masses and prevent rock fall or collapse. It involves the installation of steel bolts or rods into rock formations to provide reinforcement and support.



6. Soil grouting / strengthening

It is a ground grouting or grout injection, is a ground improvement technique used in geotechnical engineering to improve the properties of soil or rock formations. It involves injecting a fluid material, called grout, into the ground under pressure to fill voids, stabilize soil, control groundwater flow, or strengthen the ground

5. References

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