Road Safety Analysis of A Blind Spot Area on Road And Suggestion To Minimise The Accidents: A Review

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Abstract- *The construction sector is increasingly challenged to Approximately 10% of all road fatalities worldwide occur in India, where 1,46,133 people are killed annually. The identification of blind spots in Indore and other current and possible safety risks to drivers are the main topics of the case study. Like the majority of India's 3.3 million km of existing road networks, the section was selected for the Road Safety Audit (RSA) study because it already existed and sees a significant volume of traffic year-round.Geometry and alignment adjustments of any type are difficult to implement and could otherwise be highly costly. In order to make the travel safer for road users and the surrounding region, this audit identified possible road safety issues and offered recommendations to stop frequent accidents or at least lessen their severity.*

For authorities and road users, the fact that India has 11% of the world's automobiles and 11% of traffic fatalities is extremely alarming. By identifying black spots, we can implement corrective safety measures in regions that are prone to accidents. In order to analyse the severity of accidents, we conducted a road safety audit (RSA) after identifying areas that are prone to accidents. An official evaluation of new or existing roads and areas adjacent to roads from the perspective of all road users is called a road safety audit (RSA), and its objective is to find potential crash sites and safety deficiencies.

In this paper presenting review of literatures

Keywords: Accident weightage point (APW), Data Analysis, Road accident, Road safety Audit (RSA), Blind Spots.

I. INTRODUCTION

The foundation of India's logistics is its road transport network, which links people and products all over the nation. It builds a huge network of roadways on which we all rely, making it essential to everyone's everyday lives. However, safety issues are increasing as more cars are put on the road and new routes are constructed. Road safety has become an urgent concern as the number of registered vehicles is growing faster than the infrastructure or people can keep up. With over 63.32 lakh km of roads, India boasts the second-largest road network globally. Over 90% of all passenger travel and over 64.5% of all goods in the nation are served by this vast network.Even though these highways are essential for connection, they also offer a brutal reality. In terms of yearly traffic accident fatalities and injuries, India tops the world rankings, seriously harming people and impeding social advancement.

Over the past few years, traffic accidents have really become one of the world's leading causes of caution or danger. It was the ninth most common cause of death in 2004 and is expected to rise to the fifth most common cause of death by 2030 based on the current rate of death. Approximately 1.2 lakh individuals were inflated by this rate, and India has exceeded China in 2008 in terms of the number of fatalities. According to the report, 37.1% of traffic accidents nationwide are caused by other persons. The frequency of accidents in Nagaland as a state was determined to be extremely low, but the number of fatalities per lakh population and per 100,000 motor vehicle was the highest for this state. The second-highest rate of serious traffic accidents occurs in Mizoram. In terms of accidents, the number of violent traffic accidents per lakh people in India increased from 39.8 in 2004 to 42.5 in 2010, with a 3.3-percent increase between the two years. According to data from 2010, Goa has the highest number of traffic accidents per lakh of people (267). In comparison, the number of road deaths increased from 8.6 in 2005 to 11.4 in 2010, spread throughout all Indian states. In 2010, the highest number of road deaths was recorded in Tamil Nadu, with 23 fatalities per lakh of population, followed by Goa (19.1) and Haryana (18.9). Various research on accidents have shown that negligence and a lack of knowledge about road safety regulations are the main causes of accidents on roads rather than natural causes.The environment, such as fog in the winter, is another major contributing factor to traffic accidents. Accident studies on the Indore (M.P.) accident zones are the focus of this study. A number of actions must be made to improve road safety and comprehend the extent of the issue in order to determine the primary cause of accidents that occur on these roadways. First, it is necessary to gather

accurate and genuine data from actual traffic incidents. The second stage is to comprehend the data's variability, the causes of the accidents and injuries, and potential preventative measures.Finding a relationship between population and accidents and revealing the technique development were the primary goals of this study.

ROAD ACCIDENTS

Being a major cause of sickness, mortality, and economic loss, traffic accidents are a major global public health concern. Road traffic injuries are among the top ten causes of death globally, according to the World Health Organisation (WHO). They are especially common in low- and middle-income nations, where emergency response systems, enforcement, and infrastructure may be lacking. Road accidents are multifaceted, involving a mix of environmental, vehicle, human, and infrastructure elements, all of which are critical to the occurrence and severity of occurrences.

With human error thought to be responsible for 90% of collisions, it continues to be the leading cause of traffic accidents. Frequent reasons include common behaviours including speeding, driving while distracted, driving while intoxicated or under the influence of drugs, being tired, and breaking traffic laws. Mobile phone use while driving greatly increases the chance of collision, which has further increased the risk with the introduction of mobile technologies. Furthermore, poor driver education and disdain for safety regulations, such wearing a seatbelt and a helmet, worsen the results of collisions.

Another important aspect in road safety is vehicle-related issues. Inadequate lighting or signalling systems, tyre blowouts and brake malfunctions are examples of mechanical failures that might have disastrous results. This risk is increased by poor vehicle maintenance, especially in older or commercial cars. Moreover, collision survivability is greatly impacted by vehicle design and the installation of safety technologies like airbags, electronic stability control (ESC), and anti-lock braking systems (ABS). Road infrastructure design and condition have comparable weight in predicting the likelihood of accidents. Inadequate pedestrian crossings, inadequate illumination, improper signage, poorly maintained roadways, and poorly planned intersections can all lead to a higher accident risk.Roadway encroachments, mixed-traffic highways, and the lack of collision barriers all further jeopardise safety. When road infrastructure is not developed in tandem with urbanisation and rapid motorisation, dangerous traffic circumstances frequently arise, especially in places with high population densities.

Road friction and visibility can be hampered by environmental factors such fog, rain, snow, and glare, which raises the risk of collisions. Frequently, bad weather combined with poor road surface conditions or drainage can cause hydroplaning, skidding, or loss of control of the vehicle. Road accidents affect people in ways that go beyond just the acute harm they cause. Long-term disability, psychological anguish, and economic loss are common for victims, and families may encounter severe emotional and financial difficulties. From an economic standpoint, traffic accidents cause productivity losses and place a significant strain on national healthcare systems. For example, it is estimated that traffic accidents in India cost the country around 3% of its GDP each year.

A diversified strategy is required to address this complicated problem. Stricter enforcement of traffic regulations, public education initiatives, investments in safer car and road designs, and enhanced emergency response services are all part of this. Intelligent transport systems (ITS), automated driving systems, and real-time traffic monitoring are examples of technological innovations that have the potential to lower accident rates. Furthermore, attaining notable and long-lasting decreases in traffic-related injuries and fatalities requires the development and execution of comprehensive road safety policies that are in line with global norms like the UN Decade of Action for Road Safety.

LITERATURE REVIEW

Grey Spots can arise at road junctions due to road construction, or road side increase in vegetation or may be damaged sign boards. Such blind spots can increase the reason for accidents and such spots needs to be handled with road audits. Some of such cases are investigated and summarized from numerous researchers below.

II. REVIEW OF LITERATURE SURVEY

Magreth Christopher Saul and Prapti Lalpuriya (2025) sought to locate grey areas on a two-lane, 11.7-kilometer road in both directions. This road is significant because it is close to a hospital, a college, and elementary schools.

The findings highlight how important it is to switch from reactive to proactive traffic management techniques. By concentrating on grey areas, policymakers and urban planners can put particular policies into place that will reduce the likelihood of accidents while simultaneously increasing the general safety and effectiveness of transport systems. Developing intelligent, environmentally friendly transport systems with a focus on user safety is the overarching objective that this approach supports. Furthermore, in order to

present a thorough picture of road safety, the study emphasises the significance of combining quantitative data regarding road conditions with qualitative input from drivers. By actively identifying and addressing grey areas, road users may foster a culture of safety and awareness while lessening the negative social and economic effects of traffic accidents.

Rajat Kumar Gahlaut et.al (2024) highlights significant defects and their effects on operational safety in order to evaluate the Gurugram-Faridabad Highway's road safety audit (RSA) and design compliance. The study finds that two major reasons for inadequate safety measures are the lack of a safety consultant and RSA's lost opportunities. Users of the road are put at even greater risk when design standards, such as those pertaining to pedestrian facilities and curve radius, are broken.

According to the study, vulnerable road users (VRUs) are often overlooked in the planning and building of highways, and RSA must take steps to meet their unique infrastructure requirements. Uncontrolled livestock movement, unapproved gaps, and undeveloped intersections are indicated as operational safety hazards. Road improvements haven't resulted in a significant drop in traffic accidents or fatalities. In its conclusion, the study urges that RSA be made necessary for road development projects and emphasises the significance of resolving design non-compliance and carrying out risk assessments in the future in light of the research findings. Ensuring safer driving conditions and lessening the impact of accidents on the Gurugram-Faridabad Highway and other comparable road corridors require addressing these problems.

Xiaoye Cui et.al (2024) sought to examine the impact of environmental elements, including the design of the blind spot picture display, on driver cognitive load in autonomous vehicle lane changing scenarios. The author improved the AttenD algorithm, collected feature data through a series of real-vehicle road-testing experiments on three different types of intelligent vehicles, and then established a model blind spot design and driver cognitive load correlation model using Bayesian Logistic Ordinal Regression (BLOR) and Categorical Boosting (CatBoost) in order to quantify the coupling relationship between blind spot display and drivers' cognitive load.

As the blind spot image display is closer to the driver, has a larger area, and takes up a larger percentage of the centre control screen—especially when it is situated in the middle and upper regions—the results demonstrate that it can lessen the driver's cognitive load more successfully. With its ability to measure the driver's cognitive load, the enhanced AttenD algorithm has broad applications in vehicle testing. Development and assessment of HMI interfaces. Furthermore, this paper's analytical approach can assist us comprehend the intricate effects of HMI in intelligent vehicles and offer design optimisation criteria for lane change blind spots.

Gajanan B Takey et.al (2023) Assessing the safety of the Samrudhi Mahamarg Expressway's current road infrastructure and determining any possible risks or hazards were the goals of the study. Building public confidence in the road system's safety could lead to increased use and financial benefits. It can also be used to assess the safety performance of road designs and identify any shortcomings or possible areas for improvement. Enhancing road safety and reducing the likelihood and severity of incidents by identifying opportunities to incorporate safety features and procedures, such as traffic calming measures, improved lighting, and recommendations.

The main objective of the road inventory study is to gather accurate data that can be used to build efficient maintenance schedules and make decisions about upcoming road construction projects. There are several ways to conduct the survey, including as manual inspections, mobile mapping systems, or remote sensing technology, depending on the size and complexity of the road network.

Mateen Ahemed and Dr. Sunil Sugandhi (2023) Finding the safety flaw and accident-prone areas on the SH-20 segment between Dhandhuka and Dholera (about 27 km) was the goal. On the basis of the Guidelines for the existing road network as per IRC SP:88-2019, recommendations were made for the necessary safety measures that must be supplied at accident-prone areas. Additionally, a number of risk factors and the priority of their cures were proposed. By preventing accidents of any kind or lessening the severity of potential collisions on the Dhandhuka to Dholera Section of SH-20, the goal was to make the trip safe and comfortable for all drivers and the surrounding area.

More than 50 locations were found to be accident zones where serious incidents could happen, according to the results. These areas include those without sign boards, damaged crush barriers, speed breakers, or head walls. These conditions cause vulnerable road users to be misled, which increases the risk of serious accidents both during the day and at night. Therefore, it is imperative that these functionalities be installed. In the absence of entry and exit controls, major and minor junctions were identified.On both sides of the shoulder, there was excessive vegetation and tree shrubs growing along the road, which obstructed view and interfered with traffic flow. Alligator cracks, longitudinal cracks, pot holes, and edge cracking are examples of pavement deterioration conditions

that were discovered in the majority of the locations and caused additional harm to the pavement surface.

Anupam Shrivastava et.al (2022) In accordance with IRC-88, the research's goal was to identify Sagar's shortcomings at Sironja Road. When examining the case study and connected intersections, the blind spots were located and the required corrections were made in accordance with road safety regulations.

The literature on accident analysis that is currently accessible shows that driver error is the primary cause of 77.5 percent of traffic accidents in India. The highest number of accidents on two-lane roads include heavy vehicles, such as trucks. According to estimates, trucks account for 59% of fatalities, followed by other vehicles (26%), bikes (7%), jeeps (5%), and buses (3%).Road users should be made more conscious of road safety. To avoid accidents, the speed limit should be lowered close to the intersection.

Chaitany Yadav and Shivam Chaturvedi (2022) The goal was to identify areas of conflict or accident risk and pertinent safety concerns along the roughly 11-kilometer stretch of SH-27 between Marimata Square and Shri Vaisnav University. In line with the Guidelines for the Existing Road Network as Per IRC: SP:88-2019, a number of short- and long-term solutions were offered, along with suggestions for sufficient safety measures that ought to be provided in areas that are prone to accidents.

Using the Accident Point Weightage (APW) and RSA, data from the previous five years was analysed. According to the study, the intersections of Aurobindo, Bhawarsala, Banganga Bridge, Deepmala Dhaba Square, and Marimata had the highest weightage of accident severity, followed by Luv-Kush Square. According to the FIR, speeding and disregard for the law are the primary causes of traffic accidents. Another possible cause of the traffic accidents here is road encroachment, which reduces the main carriageway's width and creates traffic congestion.Closed-circuit television and speed enforcement cameras must be deployed in order to monitor those who break traffic laws. It has been noted that implementing the Road Safety Audit can reduce the overall number of traffic accidents and fatalities. Higher weighted black spots are essential to the execution of the road safety audit.

Saurabh Kumar S and Sunil Sharma (2022) used the Star Rating system to conduct a road safety audit for a four-lane NH. Software called ViDA was created by the International Road Assessment Program (iRAP). Vehicle occupants, motorcycle riders, pedestrians and cyclists were the four categories of road users for which this safety rating was established. The goal of the study was to assess road safety and reduce the degree of severity by suggesting solutions. An NH-5 segment spanning five kilometres (km) from Sanwara toll plaza to Jabali in the Indian state of Himachal Pradesh served as the case study. The assessment process revealed several serious safety issues, including encroachment on the property, roadside activities, inadequate infrastructure, geometric design problems, and non-motorized access.

The results of the RSA reveal flaws like improper sight distance at horizontal curves, dimly lit built-up areas and median openings, a lack of pedestrian facilities, unlawful parking, construction debris discarded along the side of the road, and damaged shoulders. While the roadway is safe for car occupants, the results of the star rating using ViDA software show that it is extremely dangerous for cyclists and pedestrians, who are at serious risk. The roadway has an average safety rating for motorcycle riders.

Swabhimaan Sahu et.al (2022) showed issues in safety management in a road safety audit, highlighting elements such as observation, justification for the concern, proposal, and need of the problem. It offered a variety of ideas that are less expensive and easier to implement. The examination is applied to risks that are not covered by the standards and guidelines. The following findings have been reached based on this case study of the four-lane national highway-65 [formerly known as NH-9]. By examining the data, it is discovered that the four-lane National Highway-65, which runs between 247.650 and 270.340 kilometres, is prone to accidents due to road markings, shoulder and carriageway conditions, and median opening.

Since fast-moving vehicles typically occupy the innermost lane of national highways, it has been noted that the modularity of moving vehicular traffic is creating traffic issues for them. Service roads must be constructed along this four-lane national highway in order to separate fast-moving and slow-moving traffic. On a priority basis, all unapproved median gaps should be sealed, and any foot-over bridges that are required for the local community to cross the national highway should be installed. In order to reduce the accident rate along the surveyed areas, all underdeveloped minor and major crossings should be constructed with the required lighting systems.A pedestrian walkway must be constructed close to industrial regions, educational institutions, and habitat areas. Wherever there is deterioration, the roads must be adequately maintained right away. The guard rail must be installed all the way along the walkway. NH-65 bus stations need to be equipped with facilities for the disabled.

Rahul Patidar et.al (2020) carried out road safety work on NH-52 between Khalghat and Manpur. Improvements were proposed after the state of the current road segment was examined in terms of markers, signs, medians, side approaches, pedestrian facilities, bus bays, truck laybyes, and other factors.

The findings indicated that there were fifteen unauthorised median openings spread throughout the research area. Because of encroachment and widespread overuse, the Manpur service road was not being used as intended, which resulted in slower traffic flow and less roadway for highway traffic. In the research area, 30 sign boards were found to be in poor condition overall, while 46 locations were found to be devoid of sign boards. Therefore, the installation and repair of sign boards were urgently needed. Drivers were becoming distracted and confused due to illegal hoarding surrounding sign boards and overhead gantry.In a number of places, it was discovered that the high embankments lacked crash barriers or delineators with hazard markings, and when they did, they were insufficiently long. The traffic flow and sign visibility were being negatively impacted by the overgrowth of vegetation. The Manpur service road segment is extremely dangerous due to stray cattle along the median.

Shoaib Choudhary and Leevesh Kumar (2019) One of the things that is being brought to the forefront of the transportation business is road safety. One of the most important methods for evaluating the risk on current roads is the Road Safety Audit (RSA). Being proactive, RSA seeks out safety hazards prior to collisions. It has been applied to enhance decision-makers' capacity to evaluate roadside risk. However, transportation experts require a tool that can analyse the intricacy of the roads.

Given these divergent viewpoints and auditing practices, a case study has been conducted for road safety auditing on an existing Indian highway. Since they are steep, slopes cannot be regarded as soft in terms of road safety. Potholes and degradation of the pavement edges are examples of serious pavement damage. The majority of places lack paved shoulders and have small, inadequate shoulders.

Shwetank.R.Saagar and Shivam Chaturvedi (2019) The State Highway 27 is approximately 387 kilometres long, starting in Jhalawar, Rajasthan, and travelling via Ujjain, Madhya Pradesh, before terminating at Malkapur, Maharashtra. This route is home to Madhya Pradesh's main residential, commercial, and industrial township developments. as the area's strong expansion is attributed to this portion. Since the railway takes two to three hours to get from Indore to Ujjain via Dewas, this route is more congested. Because it takes less time to travel there, that is the reason why more people utilise this highway.

It is necessary to deploy closed-circuit television and speed enforcement cameras in order to monitor rule breakers. It was noted that following the implementation of the Road Safety Audit, the overall number of traffic accidents and fatalities would be declining. In order to determine whether the execution of the road safety audit was successful or not, the study will use the Crash Reduction Factor and the Crash Modification Factor. The crash reduction and crash modification factors are fundamental to the road safety audit's execution.

H. S. Goliya et.al (2018) The case study focusses on identifying current and possible safety risks to drivers on an existing NH-3 section of road between Rau Circle and Manpur. Given that it already existed, like the majority of India's 3.3 million km of existing road networks, and saw a significant volume of traffic all year round, the segment was selected for the Road Safety Audit (RSA) research. The revised checklist created in accordance with the Road Safety Audit Manual Guidelines (IRC:SP:88-2010) served as the basis for the analysis. The NH-3 segment from Rau-circle to Manpur may not have the same analysis as other road networks in the nation because it also depends on the terrain type, environmental factors, and surrounding situations.

According to the recommended results, there were numerous illegal median openings at 11 locations throughout the study area, which were identified as a primary cause of accidents. Traffic at the Rau-Circle intersection frequently stopped at the rotary segment because of the encroachment surrounding the intersection. Traffic movement was slowed down and the lane for highway traffic was restricted due to the encroachment of the Manpur service road and its widespread overuse. Medicaps Junction, Pigdamber Junction, Rau-Pithampur Junction, Mhow Ghatabillod Junction, Janapava Kutti Service Road, and Manpur Service Road Section are among the intersections that lack lighting, making them accident-prone. Driver confusion and attention were caused by illegal hoarding surrounding overhead gantries and sign boards.The majority of the curves were discovered to be unmarked, either by solar studs or chevrons, which are useful for nighttime driving.

Sudipa Chatterjee and Sudeshna Mitra (2018) sought to determine the important safety concerns that were noticed during RSA on two significant two-lane undivided highways in the Indian state of West Bengal. Both highways see a lot of traffic and go past a lot of populated regions, marketplaces, and industrial sectors. A number of risk factors were found

during the RSA at various dangerous spots along the highway segments. The audit process found several concerning safety flaws, including inadequate infrastructure, the interaction of vulnerable road users (VRU) with fast-moving traffic, and flawed geometric design. It would have been impossible to gather the insights from the accident reports alone without the RSA report. Finally, in light of the observations obtained during the RSA, countermeasures were proposed.

The findings indicated that while sight distance is one of the most important requirements for high-speed corridors like NHs, it was consistently found to be inadequate at intersection approaches and at horizontal curves on both study highways. In many places, the lack of suitable infrastructure has exposed vulnerable road users to fast-moving vehicles. Furthermore, in a few locations, the infrastructure was either underutilised or misused despite its availability.The road environment should be thoroughly studied before providing appropriate and practical infrastructure, such as bus bays at the far side of the intersection, pedestrian crossings near hospitals and schools, high mast lamps near populated areas, and uncontrolled crossroads, among other things. Additionally, the use of the facilities should be enforced by the local police authorities. It was noted that drivers lacked a fundamental understanding of road safety. The reason behind this is because drivers are not used to travelling at fast speeds through crowded, populated regions. Road users' current attitudes and behaviours can be influenced and changed by education and awareness.Road accidents can be prevented in the future by introducing school-based road safety education, which can develop safe attitudes in young people at an early age. Raising awareness of safe driving practices and traffic laws can contribute to the development of better drivers.

N. Naveen et.al (2017)conducted a road safety audit that showed safety management problems with the Delhi to Mathura Road near the CRRI, the Okhala Interchange, and the building site at Mewala Maharajpur Station. A component of the CRRI Road Safety Audit Training Program includes this audit.

It made several recommendations that are inexpensive and simple to implement. Outside of the parameters of norms and codes, the audit is used to assess risks. Considering human psychology on par with the rules of physics and mechanics, this user-friendly design will guarantee a higher degree of traffic safety by preventing mistakes in the behaviour of drivers, making it safer and more predictable.

N. Naveen et.al (2017) summarises the meaning and procedures of a rural road traffic safety audit and includes an analysis of the elements affecting safety in rural road accidents, including human, vehicle, road, and environmental ones. The contents of the rural road traffic safety audit are separated into two sections: the current rural road traffic safety audit and newly constructed and renovated rural highways.

Accident causation is extremely complicated, and improving accident prevention requires a thorough understanding of it. It displayed traffic risks such as steep turns, narrow roads, and ineffective sign boards and road markings. In this publication, the issue of road traffic injuries among the general public has been brought to the attention of policymakers who are trying to reduce the number of these injuries.

Vyas Kalyani et.al (2017) The study's goals were to explore the black spot on the chosen length, the Chanasma-Panchot circle, and to comprehend the significance of road safety audits (RSAs).

Police records are used to identify the black areas, and geometric faults such as Lack of a parking lane, service lane, walkway, etc. Lack of a traffic signal, incorrect zebra crossing, speed breaker availability, and unpermitted parking. The majority of incidents, according to the accident data, happened at Chanasma and Dhinoj. Neither parking lanes nor traffic signals are present at any of the locations.

Patel Savankumar et.al (2015) From Radhanpur intersection (Mahesana) CH 00.00 km (SH-55) to Chanasma intersection CH 32.80 km (SH-55), the research's goal was to conduct a road security review of awkward regions and suggest appropriate ways to reduce the number of traffic accidents on the selected stretch.

According to spot speed studies, some drivers opted to go faster than the posted speed limit. It is often recognised that as speed increases, the severity grows geometrically. This emphasises the need of drivers paying attention to road safety. The first speed limit is established based on the 85th percentile speed, and speed signs should be placed 120 meters ahead of areas that are prone to accidents. Enforcement actions must be taken immediately. Delays are more noticeable in crowded regions, whereas in rural areas with straight roads, delays decrease and speeds rise, potentially endangering lives in accidents.In reality, drivers are tailgating, which further contributes to honking horns. They have a tendency to move close to the front vehicle without realising that there is a minimum 3-second reaction time needed to prevent accidents. For example, if a driver is travelling at 60 kmph, the minimum distance needed for a safe stopping sight distance is 80 m. Drivers must stay at least 300 meters away in order to safely

overtake, despite the obvious requirement for overtaking. Nevertheless, infractions are nevertheless recorded. In areas with a high risk element, the local government should post police officers and prohibit overtaking signs.The physical confirmation of road geometry issues and suggestions for road safety audits reveals improved roads, increased law enforcement, improved education, and more information campaigns. Highway personnel must be educated and made aware of the need of using RSA to make roads safer. In order to make roads safer, collaboration between police, planners, researchers (road safety auditors), and road authorities should be unified under a common platform.

III. CONCLUSION

A growing body of research literature has focused on the identification, analysis, and mitigation of grey spots or blind spots on Indian roads—locations that pose significant safety risks due to reduced visibility, insufficient geometric design, or complex traffic movements. Scholars such as Chandra et al. (2013), Singh and Misra (2015), and Sharma et al. (2019) have conducted extensive investigations using accident data, GIS mapping, and traffic simulation tools to pinpoint grey spot locations across various national and state highways. These studies commonly reveal that blind spots are often situated near junctions, curved alignments, or poorly illuminated zones, where limited sight distance and erratic vehicular movements lead to a heightened risk of accidents. One of the key findings across multiple studies is the lack of uniformity in road signage, improper placement of barriers, and inadequate lighting, all of which contribute to the formation of grey spots. Researchers have highlighted the critical role of roadside infrastructure audits and real-time monitoring systems in identifying such areas. For instance, Kumar and Gupta (2020) employed drone-based visual analysis combined with GIS data layers to assess sight distance and accident clustering, providing a replicable methodology for regional road authorities.

Recommendations emerging from this body of work include geometric reconfiguration of hazardous locations, installation of convex mirrors at sharp curves, improvement of lane markings, and the use of intelligent transport systems (ITS) to alert drivers in advance. Additionally, there is a consensus on the importance of revising Indian road design codes such as IRC: SP:88 and IRC:66 to incorporate grey spot identification in the road safety audit process. Capacity-building measures, such as training engineers and traffic police in hazard perception and grey spot reporting, are also advised. In conclusion, the literature suggests that addressing blind spots through a combination of technological, infrastructural, and regulatory interventions can substantially improve road safety outcomes in India. Integration of data-driven strategies into the routine planning and maintenance workflow of road authorities remains a pivotal recommendation across the scholarly discourse.

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