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IDENTIFICATION OF GREY SPOT FOR ACCIDENT PREVENTION THROUGH ROAD SAFETY AUDIT

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***ABSTRACT*:**

In order to bridge the gap created by conventional reactive black spot analysis, this study explores the proactive identification of "grey spots" through Road Safety Audit (RSA) as a contemporary method to accident prevention. Grey spots are possible high-risk locations that have not yet achieved critical accident thresholds but exhibit signs of safety concerns, whereas black spots are determined by historical accident data. The study starts with a review of the literature that identifies grey spots as a crucial idea for improving road safety and draws attention to the shortcomings of black spot techniques. An 11.8-kilometer stretch from Waghodia Bridge to Parul University in Vadodara, a busy two-lane road with significant pedestrian and vehicle traffic that serves schools, colleges, and hospitals, is the subject of the chosen case study. The study used a qualitative methodology that included field observations, photographic recording, and RSA checklists because police accident data was scarce. A number of "grey spots" were found, such as places with non-functional traffic lights at the intersection, Inadequate street illumination, poor street illumination and intense headlights glare, uncontrolled traffic flow and drainage problems. Every grey site was evaluated for risk and given a matching recommendation based on Indian Road Congress (IRC) guidelines. The conversation highlights how these high-risk locations are likely to turn into black patches and cause avoidable mishaps if left unchecked. The study concludes that proactive measures, such as improved signage, lighting, pedestrian infrastructure, and traffic control, can significantly enhance road safety. The main output of the research is a structured identification and classification of grey spots, providing a replicable model for future audits. However, a key limitation was the absence of official accident records, which restricted the quantitative validation of findings. The study recommends incorporating alternative data sources for a more robust analysis in future research.

***Keywords**: Grey Spot, Black Spot, Road Safety Audit.*

1. INTRODUCTION

Road safety Audit is the formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team. It is also known as the official safety performance assessment of a current or planned road or intersection by an impartial, interdisciplinary team. It finds chances to increase road user safety and qualitatively assesses and reports on any safety concerns. RSA's main goal is to find possible safety risks and suggest countermeasures to reduce the likelihood of collisions and injuries for all users of the road. (FHWA, 2022) A "black spot" is a 500-meter section of road where either five traffic incidents involving deaths or serious injuries occurred in the previous three years, or ten fatalities occurred during that time. (KRSA, 2020)

An place on a road or at a junction that, based on data patterns and predictive analysis during the previous one to two years, is at risk of turning into a black spot unless preventative steps are taken is known as a "grey spot." Grey patches show emerging trends in safety concerns that may indicate an increased risk of accidents or an increase in their severity.

Given that traffic accidents result in millions of fatalities and serious injuries annually, there is a growing global awareness of the need of road safety. Governments and transportation authorities have historically focused on identifying and addressing high-accident locations, sometimes known as "black spots." By concentrating on hazardous areas that require modification, these black spot initiatives have effectively decreased accidents. Finding black spots, however, is a reactive approach that depends on the collection of accident data over time

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before any corrective action is taken. This method frequently causes delays in resolving safety concerns, which leads to avoidable mishaps. (Chaitany Yadav1*, 2022)

Given the difficulties in recognizing black spots, a new proactive idea called "grey spots" has surfaced in road safety talks. An section of a road system that poses potential hazards but has not yet attained the accident frequency required to be classified as a black spot is known as a "grey spot." Even though there aren't many reported collisions in these regions, there may be subtle signs of safety issues, such badly designed roads, insufficient signage, or low visibility.

Instead of waiting for incidents to happen, the goal of finding grey patches is to proactively recognize dangers. Since it enables the early identification and mitigation of possible hazards, this forward-thinking approach is crucial for modern traffic safety management and supports the goal of creating safer, more intelligent road networks.

Road safety audits (RSAs), which offer a thorough evaluation of road infrastructure, traffic behavior, and user activities, are used to find grey areas. In order to identify places with possible dangers, RSAs allow auditors to assess factors such as road design, signage effectiveness, pedestrian and bicycle safety, and general road conditions. Grey areas may be identified and promptly handled with this auditing strategy, averting more mishaps. The idea of "grey spots" is becoming more popular as cities grow, traffic volumes rise, and road technology advance quickly. Early detection of any safety issues is essential as traffic volume increases and new roads are built. Grey spots are an example of a novel approach to road safety that stresses proactive risk management rather than just reacting to current threats. Road safety assessments help to reduce future accidents and make major infrastructure changes that improve safety for all users of the road by resolving gray areas.

1.1 Risk assessment of Safety Concerns and Prioritization of suggested Recommendations

IRC:88:2019 Clouse 4.6 gives insight about the risk assessment of safety concerns and prioritization when road safety audit is carried out. Table 1 below shows the criteria for risk assessment, examples and the effects according to the level of the risk. Table 2 below shows priority and suggested measures.

Table 1: Criteria for Risk Assessment

Severity	Description	Examples
Very	Multiple deaths are likely	High-speed, multi-vehicle crashes on expressways. High A bus collision at high speed with a bridge abutment.
High	A death and/or serious injuries are likely	High/medium speed vehicle/vehicle collisions. 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.

(Kama Koti Marg, 2019)

Table 2: Assigning Priority Level for Suggested Recommendations

Priority	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.

(Kama Koti Marg, 2019)

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1.2 Problem statement

Due to the huge number of fatalities and injuries caused by traffic accidents each year, road safety is still a major global concern. Finding and reducing "black spots," or locations with a high accident rate, has been the subject of several research. Through road safety audits, a number of techniques have also been created to assess and enhance the safety of these dangerous places. These audits are reactive approaches to accident prevention as they usually use past crash data to find black spots.

Black spots are helpful for identifying dangerous areas, but they mostly address road safety after an accident has already happened. Because of this reactive approach, new hazards could not be recognized until they cause serious mishaps. There is still a significant gap in the proactive identification of possible accident hazards in locations that have not yet had a high number of collisions, despite extensive study on black spots and the effectiveness of road safety audits in identifying them.

The idea of "grey spots" is presented in this paper as a remedy for this safety vulnerability. Grey spots, like black spots, are areas of roads that exhibit early warning indicators of safety issues that, if left unchecked, might result in collisions. However, unlike black spots, grey spots can be detected through safety audits before any accidents happen, allowing for a proactive approach to enhancing road safety.

The study prioritizes proactive risk identification over reactive measures in an effort to close the current gap in both literature and practice. The use of "grey spots" as a cutting-edge accident prevention technique will be examined. The study will show how these gray areas may be found by road safety audits and how fixing them can result in long-lasting increases in road safety.

1.3 Case study

The figure below shows the road section of 11.7Km 2 lane two way from Waghodia bridge to Parul University.

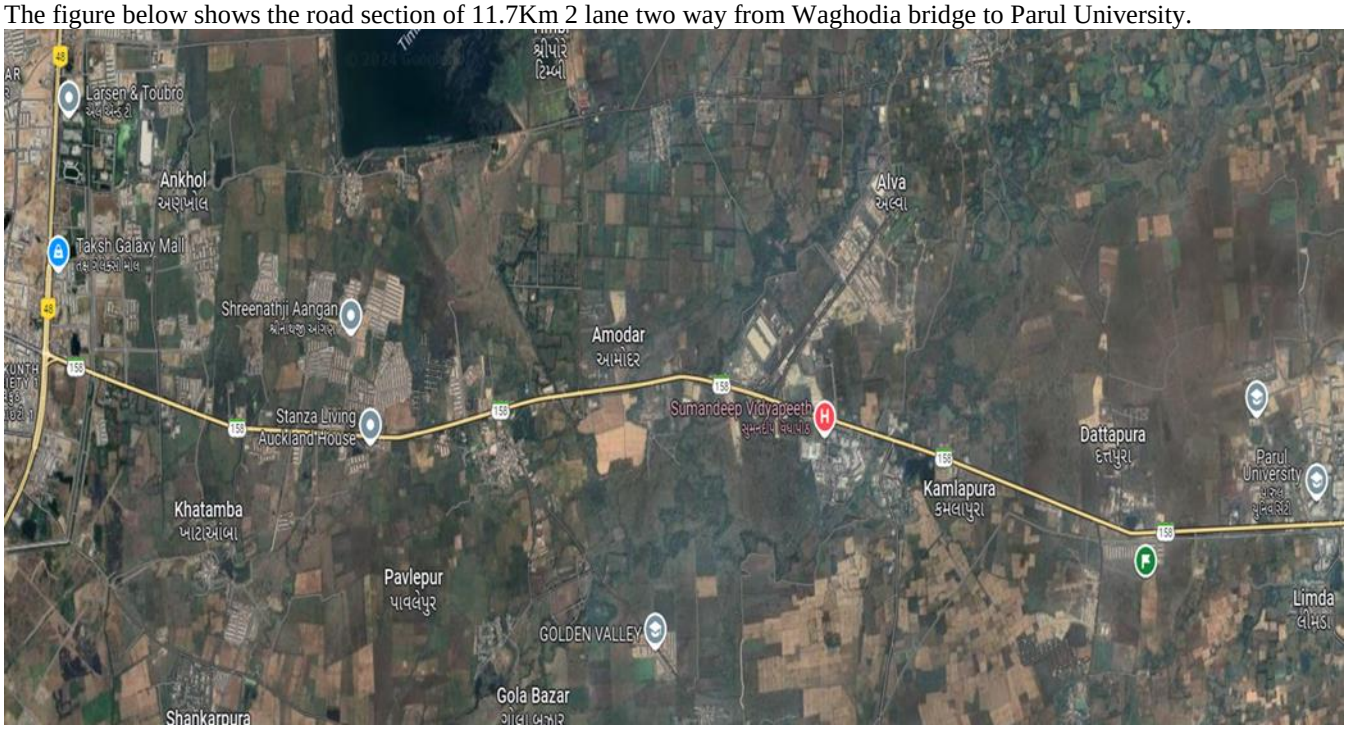

Fig.1: Shows the road section of 11.7km

The case study was preferred due to its closeness to significant facilities like elementary schools, colleges, hospitals and shops. This road is situated in a densely populated neighborhood with high foot and car traffic. Social service providers around Waghodia

- Gujarat public school
- Daroda Public School
- Parul university and Sevashram Hospital
- Amicus International School

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- Sumadeep College and Hospital

There is a lot of traffic on the road, especially during rush hour when people are traveling to and from the hospital and schools, including parents, staff, patients, and visitors. Because there are more encounters between cars and people as a result of this greater activity, it becomes more difficult to prevent accidents.

The urgent need to increase road safety for all users is what led to the decision to use this road as the focal point for identifying areas of concern. An ideal setting for analyzing possible risks is created by the heavy traffic, the presence of those who are particularly vulnerable on the road (such as children and the elderly), and the lack of adequate safety precautions in some areas.

In order to identify regions with possible dangers that could result in future incidents, the study intends to carry out thorough road safety assessments on this particular road segment. The implementation of efficient safety measures to lower accident rates and guarantee safer travel for all users of this congested thoroughfare depends on this proactive approach. (Magreth C. Saul, 2025)

2. METHODOLOGY

2.1 Introduction

Methodology pertains to the organized strategies and processes employed in research. It details the approaches used for gathering, analyzing, and interpreting data in order to address research inquiries or resolve particular issues. In the context of road safety research, methodology plays a crucial role in pinpointing risk factors, gathering data directly from the field, and formulating recommendations based on evidence.

2.2 Types of methodology

In academic research, the choice of methodology is crucial as it shapes both the focus and the reliability of the study. The methodology affects not only the process of data collection but also the analysis and interpretation of that data. Generally, there are three primary types of research methodologies: qualitative, quantitative, and mixed methods. Each type has its advantages, drawbacks, and particular uses based on the research context.

2.2.1 Qualitative Methodology

Qualitative methodology is an approach that emphasizes the exploration of phenomena through non-numerical information. It aims to comprehend meanings, experiences, and the fundamental reasons behind various behaviors or trends. This approach prioritizes depth rather than breadth, making it ideal for exploratory and descriptive research.

The approach involves utilizing various data collection methods like interviews, observations, case studies, and document analyses. It focuses on gathering narrative information, descriptive insights, and contextual evaluations. The goal is to achieve a comprehensive understanding of individuals' perceptions, motivations, and the complexities of real-life situations.

2.2.2 Quantitative Methodology

Quantitative methodology entails gathering and analyzing numerical information. It emphasizes the measurement of variables and employs statistical methods to examine hypotheses or identify relationships among various factors.

The approach involves utilizing organized instruments like surveys featuring close-ended questions, counts of traffic volume, speed assessments, and statistics on accidents. It prioritizes objectivity, precise measurement, and adherence to statistical standards. The findings are typically displayed through various formats such as tables, graphs, and charts.

2.2.3 Mixed-Methods Methodology

Mixed methods combine both qualitative and quantitative approaches to provide a more comprehensive understanding of the research problem. This methodology allows the researcher to explore the depth of individual experiences and analyze large-scale patterns simultaneously. Combines numerical information with descriptive insights to provide a comprehensive understanding. It encourages triangulation by confirming findings through

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various data sources or methodologies. This approach is flexible and can be tailored to address intricate research challenges, such as those related to road safety.

2.2 Selected Methodology for This Study

Due to the lack of accessible police accident data and official statistical records, this study utilizes a qualitative research approach. The primary aim is to identify "grey spots"—locations on the road that may represent potential safety hazards despite having no documented history of accidents. This method is fitting since these grey spots are often overlooked in traditional data-driven analyses.

The qualitative approach gave room to:

- Perform field observations and conduct road safety audits to evaluate physical conditions, such as inadequate lane markings, insufficient signage, blocked pedestrian pathways, and hazardous intersections.
- Collect photographic documentation and use organized checklists for a systematic assessment of risk factors.
- Understand the real-life context of road users, including behavioral trends and infrastructural shortcomings that could lead to future risks.

This methodology focuses on preventive evaluation rather than numerical accident statistics, which is particularly important for emerging or moderately risky roads. By leveraging qualitative methods, the research provides an in-depth, on-the-ground perspective of road conditions, aligning well with its preventive goals.

2.3 Data Collection Methods

In this research, data was gathered solely through qualitative methods, emphasizing visual and physical evaluations of the chosen road segment. Due to the lack of access to official accident records, the researcher utilized field-based techniques to collect pertinent safety information. The main methods employed were:

2.3.1 Field Observation

This entailed a thorough visit to the 11.8 km stretch of the road being studied to observe and document the current safety conditions. Systematic inspections were conducted during both peak and non-peak hours to capture fluctuations in road usage, traffic flow, and possible hazards.

Key observations included:

- Road shape and layout.
- Visibility and state of road signs.
- Existence or lack of lane markings and pedestrian crossings.
- Interaction among various road users (vehicles, pedestrians, cyclists).

2.3.2 Road Safety Audit

A qualitative road safety audit was performed using standardized checklists tailored to the local road conditions. This audit was approached from the viewpoint of different road users and aimed to pinpoint risk-prone areas (grey spots) even without prior accident data.

The audit evaluated:

- Dangerous spots with limited visibility or sharp turns.
- Inadequate or worn road markings and signage.
- Potential conflict zones for pedestrians near schools, hospitals, and public spaces.
- Infrastructure issues like damaged shoulders, potholes, or blocked sidewalks.

2.3.3 Photographic Documentation

Photos were taken throughout the audit to visually record the observed issues. These images provide supporting evidence of safety shortcomings and serve as a foundation for visual analysis in the results and discussion section. Each image was well labeled and used to highlight the specific features and all details observed during safety Audit process in the case study.

2.4 Tools Used

The following tools and resources were used during the data gathering and safety inspection process:

- **Smartphone with GPS**: Utilized to capture geo-tagged images of road conditions and features.

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- **Road Safety Audit Checklist**: A structured document that facilitated the observation process, ensuring consistency and thoroughness throughout the entire road section.
- **Notebook**: Employed for jotting down specific notes, identifying hazard points, and making rough sketches of problematic areas.
- **Reflective Safety Gear**: Worn during on-site inspections for visibility and protection while working in active traffic environments.
- **Google Maps and Satellite View**: Used as a reference to plan visits, highlight areas of concern, and compare field observations with aerial views.

2.5 Procedures

The purpose of this study was to identify and investigate potentially dangerous locations that were not yet formally designated as high-risk regions. Research methods that were both theoretical and practical were combined. A survey, on-site environmental evaluations, and a study of the literature were all part of the research process.

2.5.1 Literature Review

In the initial phase of this study, a thorough examination of existing literature on road safety, road safety audits, black spots, and grey spots was conducted. The main objectives of this review were to:

- Recognize how earlier scholars tackled the problem of black spots and the techniques they employed to find them.
- Acknowledge the shortcomings of earlier research that did not adequately examine the idea of gray areas.
- Learn about the best ways to carry out road safety audits, which may help you find areas where things are unclear.

This assessment of the literature provided the study's theoretical underpinnings and illustrated how the research helped popularize the idea of "grey spots" in road safety.

2.5.1 Observation

An essential component of this study was the observational approach. Selected areas within the research region were visited in order to perform environmental observations. This procedure included:

- Assessing safety elements, such as the existence or lack of traffic signs, road markings, traffic lights, and pedestrian walkways, by closely inspecting road conditions and related infrastructure.
- Noting problems like potholes, slick roads, obscured traffic signs, and places with insufficient markings that might cause accidents.
- Taking pictures of these issues is a straightforward way to document the dangers that might lead to mishaps in such areas.

Grey spots—areas where road conditions showed signs of accident risk but had not yet attained the point of being labeled as black spots because of a lack of collision data—were mostly identified using this observational data.

2.5.3 Data Analysis

In accordance with the principles of road safety audit, the spots that presented the most danger were identified by analyzing the case study's images, which indicated possible hazard zones. Critical safety factors, such as road surface quality, signpost visibility, pedestrian infrastructure, and overall traffic management efficacy, were used to assess each detected grey spot.

The Indian Road Congress (IRC) regulations were used to generate recommendations for reducing these dangers, guaranteeing that suggested fixes complied with accepted road safety guidelines. This methodical methodology directed the creation of workable solutions to improve road safety and validated the identification of gray areas.

2.5.4. Recommendations

Based on the analysis of environmental observations and photographic evidence, recommendations were proposed to enhance road safety. These recommendations included:

- Putting up traffic signs where none existed or were difficult to see.
- Fixing potholes and enhancing pedestrian walkways are examples of infrastructure upgrades.
- Following the rules established by the Indian Road Congress (IRC) standards, safety modifications are being implemented in high-risk zones to lessen the possibility of future accidents.

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2.5.5 Validation

Lastly, gray spots areas with a high risk of accidents were identified using the data gathered from pictures. Road safety specialists examined the suggested safety improvement solutions to make sure they could be implemented in compliance with IRC requirements.

3. RESULTS AND DISCUSSION

The findings derived from the research methods are summarized in the tabular results of this study. The study evaluated road conditions and identified possible hazard sites using field observations and photographic data. Grey spots are regions with high-risk road safety problems that have not yet been formally designated as black spots because of a lack of accident data. These locations were identified through a methodical investigation.
This study effectively identified high-risk sites in need of urgent improvement by utilizing road safety audit principles and Indian Road Congress (IRC) rules as suggestions. The results show that gray spots might turn into black spots if prompt corrective action is not taken, which could result in serious mishaps, fatalities, and property damage. This study's technique was successful in locating high-risk sites and offering well-organized suggestions for reducing traffic safety risks.

Table 3: Road Safety Audit Report

No	Audit findings			Recommendations	
	Description	**Evidence**	**Risk**	**Description**	**Priority**
1	A serious pavement markings flaw that seriously jeopardizes road safety was discovered during a road safety assessment in Vadodara, Gujarat, India. Lack of lane markers increases the likelihood of head-on and side-swipe collisions by encouraging uncontrolled driving tendencies. Additionally, the absence of boundary lines reduces nighttime vision, making it challenging for cars to stay on the road. Vulnerable users are at greater danger when pedestrian crossings are not provided, particularly in crowded places.	 ***Fig.2: Shows a road section without lane marking.***	High	Establishing distinct lane and edge lines, designating pedestrian crossings, and using retro-reflective thermoplastic road markings to improve visibility and help drivers are all essential steps in lowering these dangers. It is recommended to take immediate action to improve road safety and prevent potential collisions. The shoulder edge continuation and lane mark should be marked as shown. ICR: 35	Highly Desirable
2	The lack of a dedicated pedestrian crossing on Indrapuri Road in Bapod, Vadodara, was identified as a major safety problem during a road safety assessment. Pedestrians commonly cross roads without signage, which raises the possibility of collisions, particularly during rush hour.		High	Zebra crossings must be installed at strategic points to establish secure and defined crossing places in order to improve pedestrian safety here. According to IRC:SP:73, the zebra's breadth should be sufficient, falling between 2 and 4 meters. Additionally, using visible signage and pedestrian	Highly Desirable

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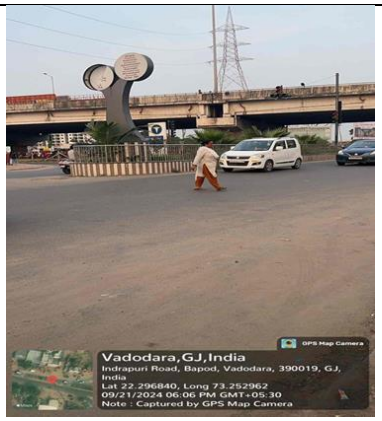
	Pedestrians must negotiate through cars in this scenario, which encourages risky conduct and slows down drivers' reaction times. Peak hours and low visibility increase the risk, making vulnerable populations—including children, the elderly, and those with disabilities—more vulnerable. Traffic movement is further hampered by the absence of crossings as cars may have to stop abruptly to avoid pedestrians.	 ***Fig. 3 : Shows a pedestrian crossing a road where there is no zebra***		signals will assist control traffic and alert cars to the presence of pedestrians. Additionally, lowering vehicle speeds at crossing areas by the use of speed-calming devices, such as rumble strips or speed bumps, can minimize the likelihood of accidents.	
3	Non-operational traffic lights have been shown to be a serious issue. Drivers and pedestrians are put in risk at this intersection because the traffic signals are either off or malfunctioning. When traffic flow is disrupted by ineffective signal management, there is a higher chance of accidents, confusion, and congestion.	 ***Fig 4: Shows non-functional traffic lights at the intersection***	Very High	According to IRC 35, traffic lights require immediate repairs. To avoid such problems, a regular maintenance schedule must be established. Until repairs are finished, temporary traffic control techniques, including police direction and portable signals, should be used. Improving traffic flow, lowering accident rates, and increasing road safety all depend on the signals functioning correctly.	Essential
4	A serious issue with inadequate street illumination at SH 158 in Vaghodia, Vadodara, was discovered during a road safety audit. This dangerous situation increases the likelihood of accidents for both pedestrians and automobiles. Lack of lighting makes it harder to see, especially at night and in bad weather, which raises the risk of major crashes. Furthermore, dimly illuminated locations might encourage criminal	 ***Fig 5: Shows Inadequate street illumination***	Very High	To increase visibility and reduce the likelihood of accidents, proper street lighting must be installed and maintained along this section of road. Consistent lighting may be achieved by installing energy-efficient LED lights at the right distance apart. Using reflective signs and road markings will also improve nighttime vision. In order to ensure that the lighting system continues to function effectively, a regular maintenance schedule should be created.	Essential

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	activity and provide safety risks to all users of the road.				
5	The image draws attention to two serious safety concerns: poor street illumination and intense headlight glare. High-beam glare can momentarily dazzle drivers, increasing the risk of accidents, and poorly illuminated roadways make it more difficult for pedestrians and cars to navigate at night. Temporary blindness brought on by high-beam glare from oncoming cars can result in lane changes, slower response times, and even head-on crashes. This lack of lighting makes it difficult to notice dangers, road markings, and pedestrians, putting pedestrians and motorcycle riders in particular risk since they are more vulnerable to low light levels.	 ***Fig 6. Shows poor street illumination and intense headlight glare.***	Very High	Installing working streetlights is crucial for increased evening visibility and traffic safety. It is essential to teach drivers how to utilize high and low lights, especially in crowded locations. Along with anti-glare measures like reflective markings and median barriers, installing signs reminding drivers to turn down their headlights would help lower accident rates and improve safety in general.	Highly Desirable
6	Critical drainage problems causing severe waterlogging have been found at SH 158 in Vaghodia, Vadodara, India, according to a road safety assessment. Potholes, uneven surfaces, and decreased road visibility are among of the dangers brought on by this stagnation, which can make driving dangerous. Two-wheelers are more susceptible to hydroplaning, which raises the possibility of accidents. Additionally, as cars slow down to avoid flooded regions, traffic congestion increases, leading to delays and increased fuel use. Long-term water buildup also weakens the integrity of the road, hastening	 ***Fig 7: Shows waterlogging caused by poor drainage system***	High	It's critical that authorities concentrate on developing an efficient drainage system with well-maintained stormwater channels in order to lower these dangers. IRC:SP:73. To improve water drainage, changes to road slopes and heights should also be investigated. Maintaining drainage systems on a regular basis is crucial to preventing silt, plastic, and other material obstructions. Additionally, educating communities on appropriate trash disposal practices might assist avoid drainage jams. Addressing these drainage issues as soon as possible would improve traffic flow, reduce infrastructure damage,	Highly Desirable

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	degradation and requiring regular repairs because of potholes and fractures. Improving road upkeep and safety requires addressing the drainage issue.				
7	According to a road safety audit, there is a serious problem with traffic control at a key crossroads on Indrapuri Road in Bapod, Vadodara, India. Uncontrolled traffic flow has been caused by a lack of traffic signals and suitable signage, which permits cars to enter and depart from different directions without a designated right-of-way. Accidents are more likely to occur in this chaos, particularly when vehicles, autorickshaws, and two-wheelers are going quickly. Poor lane discipline and uncontrolled U-turns worsen traffic and raise the possibility of side-impact incidents. All users of the road are at risk from the dangerous environment, but pedestrians are especially vulnerable because of the unpredictable movements of the vehicles.	 ***Fig 8: Shows uncontrolled traffic flow***	Very High	Prompt actions including installing traffic lights, properly marked lanes, dedicated U-turn zones, and road signage emphasizing right-of-way should be implemented to alleviate these issues. Furthermore, using surveillance cameras and traffic police to enforce traffic laws might encourage adherence to rules and reduce the number of accidents. Road safety and general traffic efficiency in the area will be significantly increased by well-designed urban roads with controlled entry and exit points.	Essential
8	The primary problem found is the absence of controlled lane changes, which causes cars to change lanes erratically because of traffic and bad road conditions, increasing the risk of crashes. When lane merging signs is unclear, drivers become more confused and behave erratically. A damaged car on the shoulder is a sign of prior collisions, most often caused by careless driving and insufficient road markers. Crash hazards are increased when different	 ***Fig 9: Shows lane interference***	High	A number of enhancements are proposed to solve these safety issues. Installing lane markers and clear signs will help drivers and reduce sudden lane changes. Roundabouts and traffic lights may be used to control traffic flow and dividing heavy and light vehicles to enforce lane discipline will increase efficiency and safety. Improving road shoulders can provide more room for pedestrian traffic and emergency stops. Strict enforcement of traffic	Highly Desirable

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	vehicle types are mixed together without a well-organized traffic flow. In addition to impeding pedestrian safety and emergency stops, narrow road shoulders increase the risk of accidents, cause traffic jams, and result in financial losses due to car damage.			laws, including sanctions for careless conduct, will encourage greater adherence and reduce the likelihood of collisions. The road's safety and traffic flow may be significantly improved by addressing these problems.	

Source (Table by Author, 2025)

4. CONCLUSION

Several extremely high-risk sites were identified during the road safety assessment, necessitating urgent repairs. In order to improve pedestrian safety, designated crossings with the proper road markings and warning signs must be established since the lack of regulated pedestrian crossings constitutes a serious risk, particularly in areas with heavy traffic. The requirement for prompt signal maintenance and optimal phase timing by IRC:93 recommendations is highlighted by the fact that poor traffic signal management at important junctions increases congestion and accident hazards. Moreover, inadequate road illumination (IRC:73) impairs nighttime vision, rendering motorcyclists and pedestrians very vulnerable; for this reason, it is essential to construct and maintain energy-efficient LED streetlights. The audit also identified areas of roads that are prone to flooding because of poor drainage, necessitating regular desilting and well-maintained stormwater systems to avoid waterlogging and skidding dangers.

Additionally, unclear road signage causes uncertainty among drivers, which encourages careless driving and raises the risk of accidents (IRC:67). Road safety, traffic efficiency, and general urban mobility will all be much improved by immediate remedial actions, such as the installation of required regulation and warning signs, stringent traffic law enforcement, and public awareness campaigns.

5. RESEARCH OUTPUT

From the road safety Audit carried out, the grey spots were identified which are high risk areas whereby are likely to be black spots in future if are not taken into consideration. The level of risk and priority of these grey spots was determined by IRC:88:2019 and the recommendations were given according to the IRC Codes as shown in the Table 2 above.

i. Non-functional traffic lights at the intersection

This area is identified as grey spot 1 from the road safety audit. This spot was found to have a high risk, which may cause accidents and lead to the death of people; therefore, it has to be taken into consideration before it becomes a black spot in future. The appropriate recommendation was given according to IRC:88:2019 as shown in Table 3 above.

Fig 10: Shows non-functional traffic lights at the intersection

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ii. Inadequate street illumination

Inadequate of street illumination was identified as grey spot 2 from the road safety Audit report because it was found as high risk area and was given essential priority according to IRC:88:2019 and the appropriate measures were given as per IRC code. As shown in the Table 3 above.

Fig 11: Shows Inadequate street illumination

iii. Poor street illumination and intense headlight glare.

According to IRC:88:2019 poor street illumination and intense headlight glare was given essential priority because was found as high risk area and therefore was identified as grey spot 3. As per IRC code appropriate measures must be taken before this particular point becomes a black sport in future the recommendation are given in table 3 above.

Fig 12. Shows poor street illumination and intense headlight glare.

iv. Uncontrolled traffic flow

This area was identified as a grey spot because of uncontrolled traffic flow, which can result to traffic collisions and lead to the injuries or death of people. According to IRC code this area was given essential priority because is high-risk area and may result to black spots in future if no measures are taken. The recommendations are given for the particular case as shown in Table 3 above

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Fig 13: Shows uncontrolled traffic flow

6. LIMITATION OF RESEARCH

The main limitation of this study was the lack of official accident data from the police, which could have offered valuable insights into past accident sites, their causes, and trends. This information would have been crucial for accurately pinpointing grey spots by examining previous incidents and relating them to current road conditions. Unfortunately, due to data privacy laws, the police categorized this data as personal and denied access. Consequently, the identification of grey spots in this research was based solely on field observations and photographic documentation gathered during the case study. Although this method enabled a thorough road safety evaluation, it missed the quantitative validation that accident data could have provided, potentially restricting the depth of the findings. Future investigations should consider alternative data sources, such as hospital records or crowdsourced accident information, to enhance the precision of grey spot identification.

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DECLARATION OF CONFLICT

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

REFERENCES

1. https://highways.dot.gov/sites/fhwa.dot.gov/files/2022-06/fhwasa14003.pdf, "federal highway administration," USA, 2023.
2. http://roadsafety.kerala.gov.in/blackspot, "Kerala road safety Authority," Kerala, 2020.

DOI: 10.46121/pspc.53.2.14

3. Kama Koti Marg, Manual On Road Safety Audit IRC:SP:78, New Delhi: Indian Roads Congress, 2018.
4. Kama Koti Marg, Manual of Specifications And Standards For Two Laning Of Highways With Paved Shoulder, New Delhi: Indian roads congress, 2018.
5. Kama Koti Marg, Code of Practice for Road marking, New Delhi: Indian Roads Congress, 2015.
6. u. R. ,. S. A. ,. K. U. ,. U. G. Asad Iqbal, "Road Traffic Accident Analysis and Identification of Black Spot Locations on Highway," *Civil Engineering Journal,* vol. 6, no. 12, 2020.
7. R. a. C. J. Sadguna Nuli, "A Study on Road Safety Audit and Black Spot Identification," *Advancements in Sustainable Materials and Infrastructure,* 2022.
8. Ankur Goyal, M. C. (2020). Accident Analysis And Blackspot Identification Of Hulasur Basavakalyana Karnataka-A Case Study. *International Research Journal of Engineering and Technology*.
9. G Sugiyanto1, R. S. (2022). Road Infrastructure Deficiency and Road Safety Audit at Black Spot Area in Rural Road. *3rd International Symposium on Transportation Studies in Developing Countries*
10. Regmi, M. B. (2021). Road Safety Policy & Practice What does it Take to Improve Road Safety in Asia? *Journal of Road Safety*.
11. Shawon Aziz, D. S. (2022). A Meta-analysis of the methodologies practiced worldwide for the identification of Road Accident Black Spots. *Transportation Research Procedia, 16*, 760 - 797.
12. Md Izharul Haque 1, A. A. (2022). Accident analysis and road safety audit: a case study on NH-76. *Advancements in Sustainable Materials and Infrastructure*.
13. Musab Abuaddous, A. A.-H.-B. (2022). Identification and ranking of accident Black Sport in Jordan. *Civil Engineering and Architecture, 10*, 1661 - 1674.
14. Chaitany Yadav1*, S. C. (2022). Identification of Blackspot and Implementation of Road Safety Audit on State Highway. Journal of Trasportation Sysytem.
15. FHWA. (2022). Road Safety Audit. U.S department of Transportation.
16. Kama Koti Marg. (2019). Manual on Road safety Audit. Indian Roads Congress.
17. KRSA. (2020). Acciends black spot. Kerala: Kerala Road Safety Authority.
18. Magreth C. Saul, A. P. (2025). Identification of Grey Spot for Accident Prevention through Road Safety Audit. Tuijin Jishu/Journal of Propulsion Technology.

DOI: 10.46121/pspc.53.2.14