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Study and Analysis of Accident Blackspot using Accident Severity Index on NH-46 from Indore-Bhopal

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ABSTRACT
Road traffic accidents are a significant public health and transportation challenge in India, with national highways accounting for a considerable proportion of fatal crashes. Identifying accident black spots is essential for implementing effective road safety measures and reducing crash-related fatalities. This study presents the analysis of accident black spots along the NH-46 corridor between Indore and Bhopal using the Accident Severity Index (ASI). The research utilizes historical accident data comprising fatal, grievous injury, minor injury, and property-damage-only crashes to calculate the severity index for different highway locations. Based on the ASI values, accident-prone segments are ranked according to their risk level, enabling the identification of critical black spots that require immediate intervention. The analysis further examines the influence of roadway geometry, traffic volume, intersection design, visibility, roadside features, and driver behaviour on accident severity. Statistical evaluation and spatial interpretation are employed to validate the identified high-risk locations and assess patterns of accident occurrence. The findings indicate that the Accident Severity Index is an effective tool for prioritizing hazardous locations by considering both accident frequency and crash severity rather than frequency alone. The study recommends targeted engineering improvements, enhanced traffic management, speed regulation, better road signage, and regular safety audits to mitigate accident risks. The proposed approach provides transportation planners and highway authorities with a practical framework for prioritizing road safety interventions, improving resource allocation, and enhancing overall traffic safety along the NH-46 corridor between Indore and Bhopal.

Keywords: Accident Black Spot, Accident Severity Index, NH-46, Road Safety, Traffic Accident Analysis

INTRODUCTION

Road transportation is one of the most important modes of transport in India, contributing significantly to economic growth and social development. With the rapid increase in population, urbanization, and vehicle ownership, road traffic volume has increased substantially over the years. However, this growth has also led to a rise in road traffic accidents, resulting in loss of life, injuries, and property damage. According to reports from the Ministry of Road Transport and Highways, road accidents remain a major public safety concern and pose significant challenges to sustainable transportation development.

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A road accident blackspot is a location on a road network where a higher number of accidents occur compared to surrounding areas. These locations are often associated with factors such as inadequate road geometry, poor visibility, unsafe intersections, excessive vehicle speeds, traffic congestion, insufficient road signs, and human errors. Identification and analysis of such blackspots are essential for improving road safety and reducing accident rates.

National Highway 46 (NH-46), connecting the major cities of Indore and Bhopal, is one of the busiest highway corridors in Madhya Pradesh. The highway serves as an important route for passenger and freight transportation and experiences heavy traffic throughout the year. Due to increasing traffic volumes and mixed traffic conditions, several sections of NH-46 have reported a significant number of road accidents, making it necessary to identify accident-prone locations and understand the factors contributing to these incidents.

The Main Objectives is to collect and compile secondary accident data related to road crashes occurring along the NH-46 Indore–Bhopal corridor from police records, government reports, and other reliable sources. Second is to identify accident blackspot locations based on accident frequency, severity, and concentration of crashes. Third is to analyse the spatial distribution of accidents using Geographic Information System (GIS) tools for accurate mapping and visualization of accident-prone areas. Fourth is to calculate and evaluate the Accident Severity Index (ASI) and other relevant road safety indicators for prioritizing hazardous locations. And study the nature and characteristics of accidents, including fatal, serious injury, minor injury, and property-damage-only accidents. To examine the major causes contributing to accidents on NH-46, such as over-speeding, road geometry deficiencies, traffic volume, visibility issues, and human factors.

The present study focuses on the identification and analysis of accident blackspots along the NH-46 corridor using secondary accident data collected from police records, government reports, published studies, and road safety databases. Secondary data analysis provides a cost-effective and reliable approach for understanding accident trends without conducting extensive field surveys. The study utilizes statistical methods and Geographic Information System (GIS) techniques to analyze accident frequency, severity, and spatial distribution. GIS enables the visualization of accident locations and helps identify clusters of accidents that may not be easily recognized through conventional analysis method.

METHODOLOGY

2.1 Study Area

The study area comprises the NH-46 corridor connecting the cities of Indore and Bhopal. This highway is one of the major transportation routes in Madhya Pradesh and carries substantial passenger and freight traffic. Several locations along this corridor have reported frequent road accidents, making it suitable for blackspot analysis.

2.2 Data Collection

Secondary Data Sources

The accident data used in this study are collected from secondary sources such as:

a) Police accident records
b) Road Safety Cell reports

c) National Highway Authority records
d) Ministry of Road Transport and Highways (MoRTH) reports
e) Published research papers and technical reports
f) Government road safety databases The collected data include:
a) Accident location
b) Date and time of accident
c) Number of fatalities
d) Number of grievous injuries
e) Number of minor injuries
f) Property damage cases
g) Type and cause of accident

2.3 Data Processing

The collected accident records are screened and organized in a tabular format using spreadsheet software.

The following steps are performed:

- Removal of duplicate records. Verification of accident locations.
- Classification of accidents according to severity. Segregation of accident data year-wise and location-wise. Preparation of a database for ASI calculation.

2.4 Accident Severity Index (ASI) Method

The Accident Severity Index (ASI) method is used to identify accident blackspots by assigning different weights to different categories of accidents.

ASI = (Nf × Wf) + (Ns × Ws) + (Nm × Wm)

Where: -

 Nf = Number of fatal accidents
 Ns = Number of serious injury accidents
 Nm = Number of minor accidents
 Wf, Ws, Wm = Weights assigned to severity Typical Weights Used

There is no universal fixed value, but standard practice (especially in highway engineering textbooks and Indian Road Congress guidelines) often uses:

Accident Type	Symbol	Typical Weight
Fatal accident	F	6–10
Serious injury	S	3–5
Minor injury	M	1–2

Where:

F = Number of Fatal Accidents

G = Number of Grievous Injury Accidents M = Number of Minor Injury Accidents

Higher ASI values indicate more severe accident-prone locations.

2.5 Identification of Blackspots

The ASI value is calculated for each accident location along NH-46. The locations are ranked according to their ASI values.

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The sites having the highest ASI values are identified as accident blackspots.

2.6 Procedure

- Calculate ASI for each location. Rank locations in descending order.
- Select locations with maximum ASI values.
- Identify priority blackspots requiring remedial measures.

2.7 GIS-Based Spatial Analysis

Geographic Information System (GIS) software is used to visualize accident locations and blackspots.

GIS Procedure

- Geo-referencing of NH-46 corridor. Plotting accident coordinates.
- Preparation of accident distribution maps. Identification of accident concentration zones. Creation of blackspot maps.
- GIS helps in understanding the spatial pattern of accidents and locating critical accident-prone stretches.

2.8 Analysis of Accident Characteristics

- The identified blackspots are analysed based on: Accident frequency
- Accident severity Road geometry Traffic volume
- Junction characteristics Driver behaviour factors Environmental conditions
- This analysis helps determine the probable causes of accidents.

2.9 Development of Remedial Measures

- Based on the identified blackspots and accident causes, suitable recommendations are proposed, such as:
- Improved road signage Speed control measures Road marking enhancement Junction improvement Street lighting installation

Crash barriers and guardrails

Khajuri – Indore-Bhopal Highway Stretch (NH-46 Corridor) Location: Khajuri area, Bhopal Highway: Indore–Bhopal Highway (part of NH-46 corridor)

11 Mile Junction (Gyarah Meel)

Location: 11 Mile (Gyarah Meel), Bhopal outskirts Highway connection: NH-46 / Indore–Bhopal route

a) Weight of fatal accident = 6

b) Weight of serious accident = 3

c) Weight of minor accident = 1 Data

Location (km)	Fatal Accidents	Serious Injury	Minor Injury	Calculated ASI
Khajuri	11	28	50	200
11 Mile (Gyarah Meel)	26	43	80	365

Original Values from the Study

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These values show that 11 Mile (Gyarah Meel) has the highest severity, meaning it is the most dangerous blackspot.

Calculation Example

For 11 Mile (Gyarah Meel) Fatal=26

Serious=43

Minor = 80

ASI = (26 × 6) + (43 ×3) + (80 × 1)

ASI = 156 + 129 + 80

ASI = 365

RESULT & DISCUSSION

3.1 Discussion

ASI focuses on fatal outcomes, not just accident frequency.

A high ASI means accidents are more deadly (even if fewer in number). Useful for identifying dangerous road sections, not just accident-prone ones.

3.2 Typical Results Interpretation

- Increasing ASI trend → accidents becoming more severe (e.g., higher speeds, poor trauma care).
- Decreasing ASI trend → improved safety (helmets, airbags, emergency response).
- Urban areas often have low ASI but high accident frequency. Highways usually show high ASI due to high speeds.
- 3.3 Key Findings (General)
- Fatalities are strongly linked to:
- Over speeding
- Poor road geometry
- Lack of safety features (guardrails, lighting)

The identification and analysis of accident blackspots have become important areas of research in transportation engineering due to the increasing number of road accidents and their social and economic impacts. Researchers have developed various methods such as accident frequency analysis, Accident Severity Index (ASI) method to identify hazardous road locations and improve road safety.

ASI = (Nf × Wf) + (Ns × Ws) + (Nm × Wm)

Nf = Number of fatal accidents

Ns = Number of serious injury accidents Nm = Number of minor accidents

Wf, Ws, Wm = Weights assigned to severity

Accident Type	Symbol	Typical Weight
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Location (km)	Fatal Accidents	Serious Injury	Minor Injury	Calculated ASI
Khajuri	11	28	50	200
11 Mile (Gyarah Meel)	26	43	80	365
Platinum Plaza	4	7	10	55
ISBT Govindpura Turn	6	8	15	75

Original Values from the Study

These values show that 11 Mile (Gyarah Meel) has the highest severity, meaning it is the most dangerous blackspot.

Calculation Example

For 11 Mile (Gyarah Meel) Fatal = 26

Serious = 43

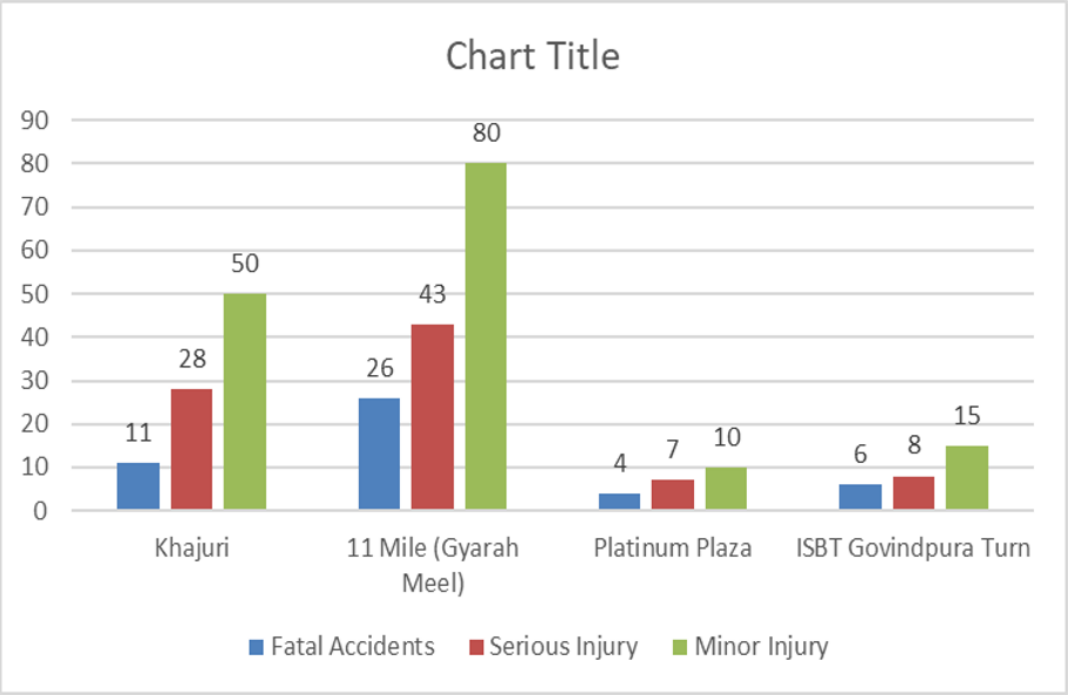
Minor = 80

ASI = (26 × 6) + (43 ×3) + (80 × 1)

ASI = 156 + 129 + 80

ASI = 365

Because the ASI value is high compared to other locations, this road section is identified as a high-priority blackspot.



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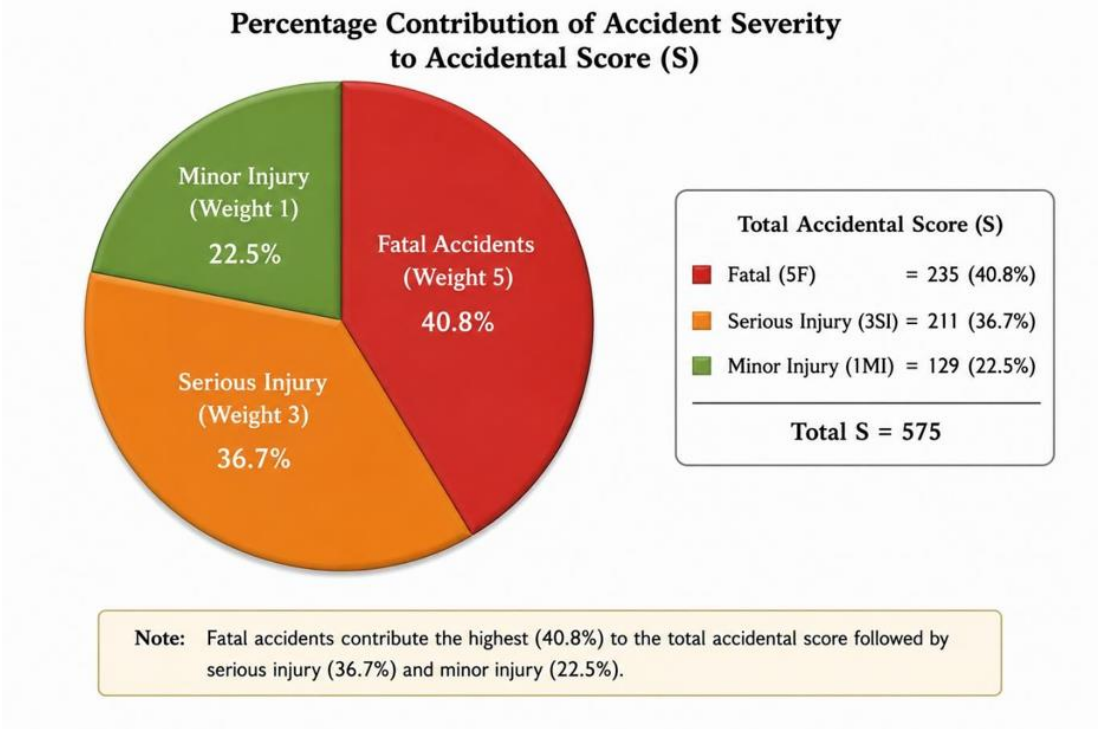

LITERATURES

1. Raut et al. (GIS Contribution for Identification of Accident Black Spots – A Review)

Raut et al. reviewed the role of Geographic Information Systems (GIS) in accident blackspot identification. The study highlighted that GIS provides an effective platform for storing, analyzing, and visualizing accident data. The authors concluded that GIS-based analysis helps authorities identify accident-prone zones accurately and supports decision-making for implementing safety measures.

2. Sandhu et al. (2016) – Identification of Black Spots on Highway with Kernel Density Estimation Method

Sandhu and colleagues demonstrated the application of GIS and Kernel Density Estimation (KDE) for identifying accident blackspots on highways. The study showed that GIS-based mapping effectively visualizes accident clusters and assists in locating hazardous sections that require immediate attention. The authors recommended integrating GIS techniques with accident databases for better road safety management.

3. Naik et al. (2016) – Identification and Analysis of Accident Black Spots on NH-147 Using GIS

This study analyzed accident blackspots on NH-147 using GIS tools and accident records. The researchers found that accident concentration was significantly influenced by traffic volume, road geometry, and driver behavior. GIS mapping enabled accurate identification of high-risk locations and provided valuable information for planning corrective measures.

4. Naga Kiran (2019) – Identification of Blackspot on SH-27 Using Accident Severity Index

Naga Kiran applied the Accident Severity Index (ASI) method to identify blackspots on SH-27. The study utilized three years of accident data and assigned weights to different accident

categories such as fatal, grievous injury, and minor injury accidents. The results identified five major blackspots along the study corridor. The research demonstrated that ASI is an effective method for prioritizing accident-prone locations based on accident severity rather than frequency alone.

5. Yadav and Chaturvedi (2022) –Identification of Blackspot and Implementati-on of Road Safety Audit

The authors employed the Accident Weightage Point (AWP) method and Road Safety Audit (RSA) to identify critical accident locations on a state highway. Their findings indicated that combining statistical analysis with field-based safety audits helps in understanding accident causes and developing effective remedial measures.

6. Review of GIS-Based Road Traffic Accident Analysis

Recent studies have emphasized the importance of GIS in accident analysis and blackspot identification. GIS-based techniques such as Kernel Density Estimation (KDE), Getis-Ord Gi* spatial statistics, crash rate analysis, and Accident Severity Index (ASI) have been widely used to identify accident clusters and evaluate accident risk. These methods provide a scientific basis for road safety planning and infrastructure improvements.

7. Systematic Review of Blackspot Identification Approaches

A comprehensive review of 182 studies on accident blackspot identification found that traditional accident-based methods remain widely used because of their simplicity and data availability. However, researchers highlighted the need to incorporate accident severity and potential risk factors into blackspot analysis to improve the accuracy of hazardous location identification.

RESEARCH GAP

Most previous studies have focused on urban roads, state highways, or national highways in different regions of India using GIS, KDE, AWP, and ASI techniques. However, limited research is available specifically on the NH-46 corridor between Indore and Bhopal using recent secondary accident data and Accident Severity Index analysis. Furthermore, there is a need to integrate accident severity assessment with GIS-based visualization to prioritize blackspots more effectively. Therefore, the present study aims to identify and analyze accident blackspots on NH-46 using secondary accident data and the Accident Severity Index (ASI) method, thereby providing practical recommendations for improving road safety along this important highway corridor.

FUTURE SCOPE OF THE STUDY

Integration of Real-Time Accident Data

Future studies can utilize real-time accident data collected through Intelligent Transportation Systems (ITS), GPS devices, and traffic monitoring cameras for more accurate and up-to-date analysis.

Inclusion of Traffic Volume and Speed Data

Future research may incorporate traffic flow, vehicle speed, and congestion data to establish stronger relationships between traffic characteristics and accident occurrence.

Road Safety Audit and Field Investigation

Detailed field surveys and Road Safety Audits (RSA) can be conducted at identified blackspots to validate analytical findings and recommend site-specific improvements.

Development of Accident Prediction Models

Statistical and predictive models can be developed to estimate future accident risks on NH-46 and other national highways.

CONCLUSION

Road traffic accidents continue to be a major concern affecting public safety, economic development, and transportation efficiency in India. The NH-46 corridor between Indore and Bhopal serves as an important transportation route and experiences substantial traffic movement, making road safety a critical issue. This study utilized secondary accident data and the Accident Severity Index (ASI) method to identify and analyze accident blackspots along NH-46. The ASI approach enabled the assessment of accident severity by assigning appropriate weights to fatal, grievous injury, and minor injury accidents. By evaluating both accident frequency and severity, the study successfully identified locations with a high concentration of severe accidents.

The application of Geographic Information System (GIS) techniques facilitated the visualization of accident distribution patterns and helped in locating accident-prone zones accurately. The analysis revealed that factors such as over-speeding, inadequate road geometry, unsafe intersections, poor visibility, insufficient traffic control measures, and human errors contribute significantly to accident occurrence on the highway.

The identified blackspots require immediate attention through engineering improvements, enhanced traffic enforcement, better road signage, speed management measures, and periodic road safety audits. Implementation of these measures can substantially reduce accident frequency and severity, thereby improving overall road safety on the corridor. The study demonstrates that the combination of secondary accident data, Accident Severity Index (ASI), In conclusion, the research contributes to the understanding of accident patterns on NH-46 and provides a foundation for evidence-based road safety planning.

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