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Accident Analysis on NH-44 Using Accident Density Method

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Abstract: *Indian society is currently quite concerned about the rising number of road accidents that occur every year. The loss of life, injuries, and property damage brought on by these traffic accidents is a grave concern. According to the Sustainable Development Goals (SDG) for 2030, providing access to safe, accessible, and sustainable transportation is urgently needed. Road safety thus becomes a crucial concern in the current situation. This study examined the NH-44 road stretch to pinpoint its black spots. The accidental information was gathered from police stations and visual assessments throughout a 48 km section of the two-lane NH-44 from Ambala to Kurukshetra. The accidental density approach has been used to do the analysis, and black spots were found. Three black spots, specifically, have been discovered. The causes of accidents in these blackspots have been identified, and preventative actions for a decrease in accidents along this stretch have been proposed.*

Introduction

The rapid expansion of multiple lane roadways and vehicles raises grave concerns about road safety. The number of people killed in traffic accidents is rising every year. The deaths and injuries caused by car accidents are a worldwide problem, but the situation is getting worse due to the heterogeneous traffic on Indian multiple-lane highways. The second biggest threat to human life, after natural disasters, is automobile accidents [1]. Given that traffic accidents are the leading cause of fatalities, road safety has now become a crucial concern. Additionally, it has been estimated that the financial damage resulting from property destroyed in traffic accidents and lost workdays as a result of physical injuries cost billions of rupees yearly. Therefore, the World Bank mandated that all highway projects funded by the organization be subject to a safety point of view audit. According to usage, India has a total of 87 national highways (country roads, state highways, and national highways) [2].

In India, vehicle traffic accidents are a serious and expanding public health issue that cause both deaths and injuries. Every week, traffic accidents result in 9,000 injuries and about 2,650 fatalities. In India, vehicle accidents caused 137,423 fatalities and 469,900 injuries in 2013, the most recent year for which statistics is available. With approximately 140,000 deaths per year, India has surpassed China to take the top spot in the world for road fatalities as a result of traffic accidents. India is the only country in the world where traffic accidents result in more than 15 fatalities and 53 injuries every hour. While the situation is generally improving in many developed and developing nations, including China, India is seeing a worsening situation. If the pattern holds, there will be a 100% increase in road traffic fatalities in India between 2013 and 2027. By 2025, India's total number of traffic fatalities is anticipated to surpass 250,000 without more effort and innovative programs.

Since the danger of being hurt in an accident is mostly predictable and numerous effective remedies are available, road traffic fatalities and injuries can be avoided to a substantial extent. A comprehensive strategy

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with tight sectoral collaboration would be the most efficient way to lower fatalities and injuries. Multisectoral strategic plans are resulting in gradual decreases in the number of traffic accident fatalities and injuries in several parts of the world. These tactics concentrate on the four main risk factors for road accidents: exposure, behavioral risk factors, road environment, and vehicle risk factors.

The measures that try to lessen exposure to risk are perhaps the least frequently employed when it comes to improving road safety. Road traffic risk results from the necessity to travel in order to seek employment, further education, or leisure activities. In order to lessen the demand for long-distance travel, it is necessary to build regional economies as well as self-sufficient compact townships, which would reduce the need for short-distance travel within cities. The mixed nature of road traffic on India's roadways, where pedestrians, bicycles, mopeds, scooters, motorcycles, auto-rickshaws, taxis, vans, cars, lorries, and buses share the same road space, further exacerbates the problem of road accidents.

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The most frequent cause of traffic-related injuries and fatalities is other road users' behavior, including how they drive, bicycle, or walk on the street. The primary variables of accident and mortality risk are the driver's age and experience, alcohol and drug usage, weariness, acute psychological stress, and enforcing traffic regulations. Inexperienced drivers are typically considered to be high-risk road users, and in recently motorized countries the risk is heightened by the presence of a disproportionately large number of new drivers. The risk is further enhanced in nations like India when rapid expansion is coupled by insufficient testing and training facilities for drivers.

As was previously mentioned, the speed of moving vehicles has a significant impact on traffic accidents and consequent fatalities. The legal speed limit is simply one factor that affects drivers' choice of speed; other factors include the driver's age and experience, alcohol and drug usage, psychological state, road design, traffic volume, condition of the road surface, and the degree of speed limit enforcement. Drivers are still reluctant to embrace the possibility that the speed they choose to travel at could make other road users and themselves more vulnerable to accidents. Focusing on altering drivers' perceptions of speed risk is necessary to lower the probability of accidents.

The degree of traffic law enforcement and the severity of the consequences for violations also affect how other road users behave. The efforts undertaken to increase road safety through legislation are frequently undermined by weak enforcement. Without enforcement, education, and media campaigns to increase

public knowledge of the aim of the legislation, merely passing laws is rarely effective. Education, advertising, and information can establish common societal norms for driving safety when utilized in conjunction with laws and law enforcement. Education, information, and publicity alone, nevertheless, rarely result in significant and long-lasting decreases in unintentional deaths and injuries. As a result, the government must adopt a systems approach to road injury prevention, which entails utilizing legislation and law enforcement with the assistance of education, information, and publicity campaigns, in order to influence road user behavior and subsequently lower the rate of road accidents and related fatalities and injuries.

Human mistake is the primary factor in the majority of traffic accidents. 78% of all accidents, 76.5% of all injuries, and 73.7% of all fatalities in India in 2013 were the result of driver error. Because of this, efforts to improve road safety have historically concentrated on 'fixing' the driver to reduce collisions. There is no question that strategies involving road-safety education and enforcement, such as wearing seat belts, always wearing a helmet while driving, saying no to driving while intoxicated, and general adherence to traffic rules are essential in reducing traffic accidents, but it is equally important to recognize that people will always make mistakes. Therefore, it is important to concentrate on minimizing the effects of accidents by creating safer cars and safer roads. By creating vehicles and roads that work together to ensure that crash energy do not overwhelm a person, it is possible to protect the user of the road in the case of an accident. Road design must make sure that vulnerable road users like walkers, bicyclists, motorcyclists, and those using unofficial public transportation are not exposed to high-speed traffic. Roads should therefore be made in a way that is not only self-explanatory but also forgiving.

Literature Review

Numerous scholars have conducted studies and research on improvements to road safety for a given location or chosen length in various ways. This work conducts some reviews pertaining to the analysis of accident data.

[3] examination of the accident and the discovery of dark spots Its goal was to analyze data on traffic accidents and pinpoint any black spots. In this study, five years (2010-2014) of accident analysis were completed. According to the findings, 509 accidents had place between 2010 and 2014. based on the highest accident rate in the research area, the black spot was located. Finally, they came at the following conclusions based on accident analysis:

- The majority of accidents, according to estimates, are caused by head collisions when there is no facility for a median on the middle lane.
- The greatest percentages of two- and four-wheeled vehicles in all traffic accidents are 20.62 and 27.50 respectively.
- The months of March and April saw the most accidents.
- The majority of accidents (42.63%) occur during the summer.

[4] Its goal was to analyze the traffic accidents that occurred along a specific stretch using a statistical method, which is under pressure due to a lack of management and an increase in accident numbers due to the large number of road users, particularly four-wheelers. It accomplishes an exploratory analysis of the accident data and offers corrective actions for a decrease in accidents on long distances. From numerous police stations along the research area stretch, accident data was gathered. The collected data are analyzed based on the following parameters: yearly variation of accidents, classified by month, day, collision type, accident spot, vehicle type, time, vehicle maneuver, drivers' error, drivers age, weather, and alcohol/drugs. Have completed their work using the suggested safety precautions.

[5] The goal of a study on black spot identification was to collect accident data for the previous five years on Islampur and Ashta Road, identify the road's black spots, carry out surveys on the areas surrounding the black spots, and provide corrective measures to reduce accidents on the chosen road.

[6] The study's goal was to investigate the current situation and identify the black spots in the study area. It was conducted in Ahmedabad City. The Sola-High Court Police Station collected accident data during the past five years, from 2008 to 2012. A survey of the inventory was conducted in five separate places. At specific points, the width of the walkway, the median, and the service lane are also measured. The study area's five places' inventories are summarized. A spot speed assessment is conducted between Thaltej Cross Road and Umiya Campus. Five areas were used for a pedestrian study during peak nighttime hours between Thaltej Cross Road and Umiya Campus. Thaltej Circle has the highest volume of pedestrians among these, at 1325 per hour. A classified volume count survey was conducted between Thaltej Cross Road and Umiya Campus during morning and evening peak hours, and a "black spot" was identified based on the number of accidents reported, the speed that was observed, the deficiency of the geometry, and the volume of pedestrians.

Problem statement

In 2018, among the 199 countries, India had the highest number of fatal road accidents. India was home to almost 11% of all accident-related deaths worldwide. India's states and union territories reported a total of 467044 road crashes in 2018, resulting in 151417 fatalities and 469418 injuries. A total of 449002 accident instances were registered on Indian roads in 2019, resulting in 151113 fatalities and 451361 injuries. A total of 354796 road accident instances were reported for the year 2020, with 335050 injured and 133201 fatalities. Driving recklessly or dangerously is a factor in 24.3% of collisions, which results in 35219 fatalities and 77067 injuries. Poor weather only accounts for 2.4% of traffic accidents (Ministry of Home Affairs India National Crime Records Bureau 2020) [7]. Table 1 summarizes the accident data by year.

In order to decrease accidents on various highway sections, researchers have employed a variety of direct and indirect approaches to analyze the collision black patches on roads. In the indirect method, investigations on accident frequency, accident rate, and traffic conflict strategies were conducted using accident data from prior studies [8]. On existing roads, post-construction safety assessments were carried out to determine the requirements for road users' safety in order to reduce accidents. A 45 km long, newly built stretch of the national highway NH-58 with four lanes is chosen. The two main flaws were that the design speed is 100 kmph while the earlier average speed is 30-40 kmph, which were discovered at Meerat and Muzaffarnagar (Uttar Pradesh). The cost of accidents and the volume of traffic were computed for this spot speed survey. Critical risk concerns for the two-lane undivided road in west Bengal, India, including a lack of infrastructure, connections between dangerous road users and heavy traffic, and flawed geometric patterns [9]. The project Saferbrain, funded by the European Commission, aims to improve road safety for vulnerable road users (VRU) in Brazil and India. Using safety precautions, corrective and preventive measures, and RSA, a decision support system built on a GIS is presented to reduce the likelihood of VRU accidents. Additionally, the efficiency of preventive measures utilized on roads was evaluated using the PC Crash approach [10]. The primary crash locations on the Beed Pass Road section that runs through Aurangabad City in Maharashtra, India, were identified. Based on the parameters investigated for crashes and the causes of accidents, preventive measures were suggested [11]. In order to learn more about various road accident-related findings and suitable recommendations derived from safety audits completed on freeways, road safety analysis was also conducted on Attica. In this analysis, accident data or various primary data were collected, and field inspections were conducted. The authors also paid attention to how all drivers see the road. They had gathered information on traffic accidents, estimated accident rates,

identified accident hotspots in Russia, and offered preventive methods. Additionally, a 25.45 km length in Karnataka was chosen to travel through Hulsar-Basavakalyana (SH), where accident data from the previous three years was gathered and the accident severity index approach was employed to analyze crashes [12]. The 10.500 km of the NH-12 between Durgapura Bus Stand to India Gate that has to be improved for road safety has three areas that have been labeled as "black spots": India Gate, Haldighati Marg, and Pinjorapole Goshala. Road signs, road markings, and unapproved median openings are some of the stretch's deficiencies. According to the government procedure followed by the respective countries, a meta-analysis of various approaches used in various regions and countries around the world for the identification of accident black spots is conducted [13]. In addition, three components were used to reduce the causes of crashes: accident assessment, functional adjustment, and intervention priorities [14].

According to the literature review, a number of researchers have conducted road safety analyses on rural and urban roads, as well as National Highways (4, 27, 58, 117, and 60), but very little research has been conducted on the section of NH103. The work on traffic volume study, spot speed survey, crash density method, sliding window method, and PCcrash software was done in the research that was presented, but the idea of accident severity index to calculate black spots is rarely employed.

In this study, the black spots on NH-44 (From Ambala to Kurukshetra) were identified using the Visual method and the Accident Density Method, and the corrective actions are advised to reduce the number of incidents on the road.

Area of the study

The region considered for the current study is NH-44, which spans from 29.9695° N, 76.8783° E (Kurukshetra) to 30.3752° N, 76.7821° E (Ambala). with a 48-kilometer length in Haryana, India. The NH 44's geometric layout and surrounding geography make it more accident-prone. Figure 1iillustrates the selected area to carry out this study.

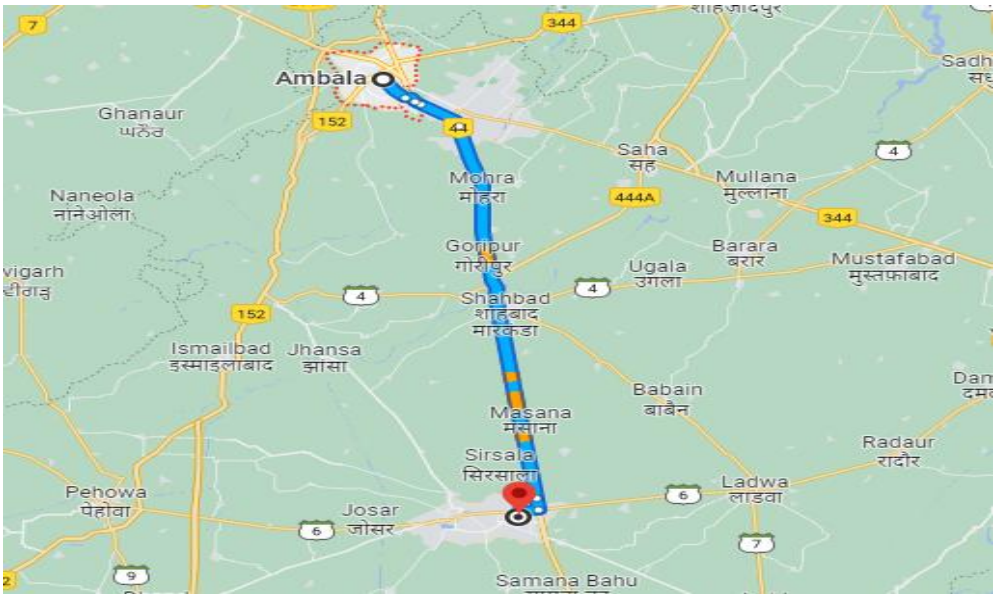

Fig. 1. Area of Study

Methodology

Data Collection: First, the incidental data was gathered from a number of police stations along the 48 km stretch of NH 44 *(From Ambala to Kurukshetra).* The accident data, which included the accident's location, kind, categorization, and type of causalities, was summarized along with the accidents themselves.

Analysis of collected data: In this work, the following techniques have been used to analyze the inadvertent data that was gathered.

1. Visual Survey
2. Accident Density Method

The data are divided into various categories in order to be analyzed:

• Types of accidents include overturning, head-on collisions, rear-end collisions, side impacts, hits to stationary objects and parked cars, among others.

• Fatal, major, and minor accidents are categorized

Visual Survey

In the current job, the road conditions were assessed by doing a visual examination on NH103 and determining the stretch's on-site state. The visual survey is broken into the following stages:

Selecting parameters: It is essential for identifying unintentional dark spots. In our study, we will solely take into account the objective factors. The parameters are further separated into two categories: subjective and objective parameters. The selection of objective criteria over subjective criteria was made because engineering solutions that adhere to Indian road standards can be used to control them. The criteria can be chosen by reading articles from international journals and talking to other drivers.

Physical Survey: It is a real-world survey that is carried out on a road. The entire stretch of NH-103 must be separated into manageable portions, and each segment must have the criteria selected visually examined.

After analyzing the primary data gathered from the police station, field data, or secondary data, was visualized and examined, we had spoken with road users and conducted interviews regarding the lack of safety on NH103. Following all of the analysis and the road users' concerns, we then studied various Indian Standards and International journals regarding road safety and provided suitable corrective measures that should be put into place by NHAI.

Accident Density Method

According to this measure, the accident density is the number of collisions per mile of a highway. Road segments that experience a disproportionately high number of incidents are categorized as excessive accident-prone places. For calculations of accident density, the following relationships are taken into account:

$$\text{Accident density up to particular section} = \frac{\text{No. of accident up to particular stretch}}{\text{Unit length of road}}$$

$$\text{Accidental density benchmark} = \frac{\text{Total number of accidents on selected stretch}}{\text{Total length of selected stretch of road}}$$

Result and discussion

Visual Survey

There are numerous factors that might cause accidents; however the following factors are the most common ones:

- visibility at intersections
- Unsuitable shoulders
- A little secondary road coming together at an unapproved junction.
- Inadequate road transitions v. A lack of side rails
- Bus stations without security, roadside stalls, or road encroachment
- Lack of road markings, reflectors, or sign boards.
- Road surface condition.
- Drainage facility
- An improper median or divider.

Accident Density Method

The number of accidents per unit length on a specific road coverage is calculated to define accident density, as shown in table 1. If accident density exceeds 1.6, the standard for accident density, it is referred to as a "blackspot," whereas if accident density is lower, there is a lower probability of collision and fatalities. Three blackspots are identified by this research on the chainages of 0–6 km, 13–18 km, and 43–48 km.

Table 1. Outcomes for Accident Density Method

Road coverage (Km)	Fatal	Serious	Minor	Accident density	Accident density benchmark	Black spot
0-6	4	2	5	1.83	1.6	✓
7-12	1	1	3	0.83	1.6	Safe
13-18	2	1	8	1.83	1.6	✓
19-24	0	1	2	0.50	1.6	Safe
25-30	0	2	4	1.00	1.6	Safe
31-36	3	3	2	1.33	1.6	Safe
37-42	2	2	4	1.33	1.6	Safe
43-48	1	2	8	1.83	1.6	✓

Figure 2 displays a black line for accident density and a red line for the benchmark. Accident density less than 1.6 is regarded as a low risk factor on the road, whereas accident density greater than 1.6 is seen as a high risk of accident and is designated as a blackspot. Using the Accidental Density Method, 3 dark stretches, each measuring 6 km, as shown in Figure 2.

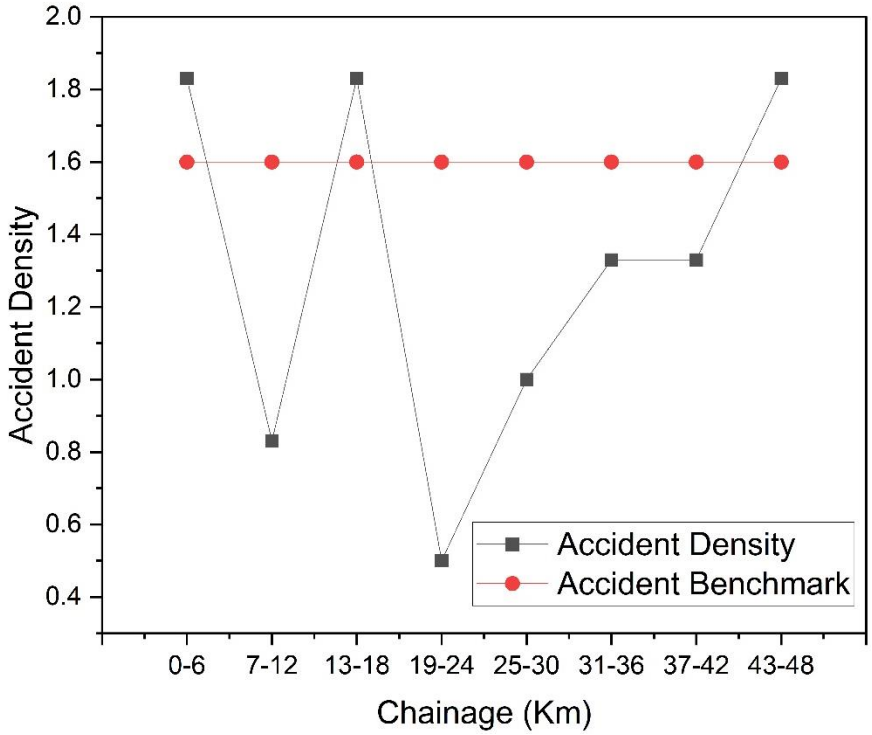

Fig. 2. Relationship between chainage & Accident Density

Conclusions

The purpose of this study was to identify accident hotspots on National Highway 44. Three hotspots were consequently found, and the following remedial actions to lower the accident rate have been recommended. Based on the study, the following conclusions were made:

1. Due to the shops on the shoulders and the highway, there was congestion. Shifting vendors and installing guard rails along the side of the road are two potential corrective measures.

2. The problem of nighttime visibility limitations. Given that the temple area is frequently busy, enough illumination should be offered.

3. The issue of water logging brought on by the road's low level. Drains should be built, and the necessary filling performed.

4. Visibility at night will be improved by placing enough streetlights close to populated areas and installing reflectors on roads.

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