

Identification Of Accident Zones And Road Safety Recommendations In Indore Region (M.P): A Review

Deepak Kumar¹, Hitesh Kodwani²

¹Dept of Civil Engineering

²Assistant Professor, Dept of Civil Engineering

^{1,2}Sam Global University, Raisen-464551, Madhya Pradesh, India

Abstract- Road accidents are now more than just a transportation issue; they are societal issues that require attention in order to be addressed. Road accidents cause significant financial and human losses, which ultimately hinder a country's ability to develop. Numerous studies on the analytic techniques of traffic accidents have determined the impact of different factors on traffic accidents. These studies also proposed corrective actions based on location and black-spot requirements.

In this paper presenting review of literatures related to analysis of accidental prone studies and its impact of road traffic.

Keywords- Accidents, environmental aspects, fatalities, geometric design, road user characteristics.

I. INTRODUCTION

The vehicle's volume continued to rise over time at a rate that was at least as fast as the human population's growth rate. With so many different types of traffic and a significant rise in the number of heavy and fast cars on the road, the current roads are not able to handle the demand. It created a highly adverse circumstance, or perhaps one of the most significant traffic issues ever, which resulted in a road accident that claimed several lives and caused significant property damage. Road safety and traffic engineering experts are needed to address this terrible loss in terms of both money and people. Along with assessing the incident's seriousness, they must also recommend certain actions to effectively address the issue.

Accident scenarios are typically caused by a variety of factors, some of which include inappropriate road user behaviour, poor vehicle condition, an unscientific approach to evaluating and investigating traffic accidents, a lack of law enforcement oversight over traffic, the uneasy availability of adequate, quick medical care, and ineffective traffic management planning.

II. LITERATURE SURVEY

Human error accounts for around 70% of traffic accidents, while road defects account for about 3-4%. Even more terrible than atomic or hydrogen bombs, traffic accidents are among the largest man-made disasters.

Divyanshu Dev et.al (2024) To identify blackspots and perform a road safety audit there in the future, the study paper's goal was to determine the various causes of accidents, along with their location and frequency. Over a seven-year period, data was collected from the several police stations that serve the Kasna to Surajpur region. The data collection period lasted from 2015 to 2021.

According to the results, the route from Kasna to Pari Chowk is the dangerous, according to Gautam Buddha Nagar Police. The DND Flyway, Rajnigandha Chowk, the roundabout at Parichowk, the zero points of the Noida-Greater Noida Motorway, the Yamuna Motorway between Kasna and Parichowk, Surajpur, Pari Chowk in Greater Noida and Jewar Toll Plaza are some of the local black spots. Five percent of accidents involve trucks and lorries, 1.22% involve buses, 1.43% involve tempo/vans, 16.42% involve jeeps, 14.47% involve cars, 11.84% involve three-wheelers, 18.42% involve two-wheelers, 10.15% involve bicycles, 10.21% involve pedestrians, and 4.80% involve unidentified vehicles that collide with something and run away.

Electricwala Fatima et.al (2024) To determine the essential elements that contribute to road safety, a thorough investigation was thus carried out. The design of roads, the design of automobiles, the function of the Indian legal system, the role of the Indian medical system, the role of the law enforcement agency, and the general public's awareness were the six main elements that were determined in order to create the road safety index. Through primary data collecting across different demographic segments, the relative significance of these factors was determined. In order to create the Road Safety Index, the Logarithmic Goal Programming Model was used to calculate the weighting depending on the significance of these criteria.

Shijian He et.al (2024) presented an innovative approach to road alignment recognition by using image recognition technology to extract alignment perspective features from real-world driving photographs. These features include alignment perspective kurtosis (APK) and alignment perspective skewness (APS). Road segments are then classified using the K-means clustering algorithm based on APS and APK markers. For clustering, different sliding step lengths are used, with step lengths varying from 100 to 400 meters. Additionally, to investigate the connection between alignment perspective aspects and traffic safety, the accident rates for various segment clusters are examined. A case study is chosen from a 150 km mountain road segment of the Erliahaote-Guangzhou motorway that connects Huaiji and Sihui.

Shorter segment lengths and fewer cluster centres yield better clustering performance, indicating that using alignment viewpoint features as a classification criterion yields favourable clustering results. While conventional two-dimensional parameters-based classification approaches are unable to capture these disparities, the alignment viewpoint features-based categorisation of road segments reveals significant variations in accident rates across categories. The largest disparities in accident rates between groups are seen at 100m segment length, where the importance progressively decreases with increasing segment length and vanishes completely at 300m.

Mateen Ahemed and Dr. Sunil Sugandhi (2023) The study's goal was to identify areas of the SH-20 between Dhandhuka to Dholera (about 27 kilometres) that were unsafe and prone to accidents. According to the Guidelines for the existing road network as per IRC SP:88-2019, suggestions were made based on this for the necessary safety measures that must be implemented at accident-prone areas. Additionally, a number of risk factors and treatment priorities were proposed.

Over fifty locations were identified as accidental zones where serious incidents could occur. These areas include damaged headwalls, damaged crush barriers, lost speed breakers, and no sign boards. These conditions cause vulnerable road users to be misled, which increases the risk of serious accidents both during the day and at night. Therefore, the installation of these functionalities is urgently needed. Tree bushes and other vegetation grew excessively on both sides of the shoulder, obstructing visibility and making it difficult for cars to flow along the route. Pavement deterioration conditions, including potholes, longitudinal cracks, edge cracking, and alligator cracks, were discovered in the majority of the places that caused further damage to the pavement surface.

Nihalahmad Riyaj Faras and Dr.V.T. Gaikwad (2023)

According to the study, a two-way, double-lane bypass road was designed. It would follow the current state route 75 from its starting point (Pashchim Maharashtra Patra Depot, Sangli) at N16053.648' E074035.344' to its end point (near Kavalapur Bridge) at N16056.042' E074037.246'. Heavy traffic will be redirected from the current road alignment by this bypass route. The 6.200-kilometre section of the SH 75 highway that currently runs through the villages of Kavalapur and Budhgaon makes the road alignment more difficult for drivers because it has many sharp curves and encroachments that block passengers' views, lowering visibility. Additionally, the presence of important assets like public assets and religious monuments prevents road widening.

Along with this bypass road alignment, asset mapping is to be done for public utility purposes simply by providing bus stops, petrol stations and other public utilities wherever needed along the stretch of these bypass roads. This 5.8-kilometre bypass road eliminates steep curves and removes the complications associated with widening the road, which will ultimately save fuel consumption and improve visibility and reduce accidents.

Xinye Wu et.al (2023) The two-dimensional point collision dynamics, which fully account for both vehicle rotation and plane motion, served as the primary foundation for the study. The safety threshold between the radius of the circular curve and the road superelevation under various velocities is determined by using vehicle rollover as the critical condition in the dynamic model analysis of the vehicle–road coupling obtained after the collision, by the kinematics principle. The road alignment optimisation scheme was then put out, which was based on the rollover stability of vehicles following collisions. The optimisation scheme's reasonableness was finally confirmed by PC-Crash simulation.

By using PC-CRASH simulation, the optimisation scheme's circular curve logic was confirmed. In order to improve and optimise road alignment design, this study optimised the pertinent road alignment indicators from the standpoint of vehicle crash mechanics. Additionally, it has significant guiding implications for the development of safety management strategies for driving vehicles.

Ancy Genu C George et.al (2022) Road geometric design features of a curving road stretch were identified and examined in the research paper. Near the AVM Hospital in Karinkunnam, a 350-meter section of the Muvattupuzha Punaloor road served as the study area. There were four consecutive turns in the road.

The complete station and AutoCAD are used to determine the geometric features, such as the carriageway width, super-elevation, extra-widening, and radius of curvature. Road signs and road studs installed incorrectly, blind spots on curves, difficulties with superelevation and extra-widening, and an inadequate radius of curvature are some of the causes of accidents. Mitigation strategies are proposed to lower the number of traffic accidents. The most effective way to lower the accident rate is to modify the roads.

Chenwei Gu et.al (2022) aims to investigate the interdependent features and contributing causes of multi-fatality crashes by merging rules graph structures and association rules mining in a unique framework. In this case study, data from 1068 serious fatal crashes in China between 2015 and 2020 are used, and an association rule mining technique is used to yield 1452 intriguing rules. Graph theory is used to build several modular rules graph structures that represent the relationships and patterns among various variables.

According to the findings, the main variables about the driver, vehicle, road, environment, and accident, respectively, include run-off-the-road collisions, inappropriate operations, passenger overload, fewer lanes, and hilly terrain. These characteristics are also strongly linked to multi-fatality crashes. Additionally, crashes with varying severity levels, road types, and topography are confirmed to have autonomous crash patterns and distinct association rules. Additionally, the percentage of serious crashes that are caused by a mix of road, vehicle, human, and environmental variables (43%) is significantly greater than the percentage of routine crashes (3%). At the system level, the crash mechanisms and interconnections pertaining to multifatality accidents are more intricate than those for typical crashes. By efficiently mapping the inherent relationship between several accident variables and possible hazards, the suggested framework can give transportation authorities useful information for focused safety precautions and preventative tactics.

Devesh Kumar and Deepak Mathur (2022) The study's goal was to create a road safety audit methodology for Four-Lane National Highway-48 and pinpoint the road network's shortcomings that resulted in accidents and safety risks for drivers.

According to the results, most minor intersections had vegetation-related sight distance issues as they approached the major route. Additionally, no informative sign boards were displaying the name of the primary highway access lane. There have been more accidents reported in those sites. There were no safety barriers in the vicinity of communities, around

curves, or in high embankment areas. In certain places, the stiff concrete safety barriers were not correctly attached to the safety barriers. Furthermore, it was discovered that locals were causing damage to the median kerbs in certain areas of the study stretch that were being used as unapproved median openings. Incorrect U-turns were discovered, without informative sign boards and solar blinkers.

Md Izharul Haque et.al (2022) The enforcement agency provided the accident data through recorded accident FIRs from 2017 to 2019, and a 93.5-kilometer span was selected. In order to ascertain the causes, the accident data was examined, accounting for yearly, hourly, time-wise, day-wise variance, accident type, and other parameters. Additionally, the research region was found to have black patches, and analysis-based recommendations were produced to reduce traffic accidents and improve user safety. The research's objectives were to identify defects, enhance design features, and raise the road's trustworthiness.

The hamlet intersection on the motorway was the site of numerous accidents, according to the results. The highest number of accidents were recorded during peak hours (17–18) and off-peak hours (12–13). Compared to nighttime, there were more accidents during the day. Most fatalities were caused by collisions between two-wheelers and heavy commercial vehicles (HCVs). There were a significant number of accidents during the July–August monsoon season, which demonstrated a lack of drivers' attention to detail under adverse weather conditions. The majority of accidents are brought on by inadequate pavement markings and management.

Saurabh Kumar S and Sunil Sharma (2022) Using the Star Rating approach, a road safety audit was conducted for a 4-lane NH in the research paper. Road sections' Star Rating is determined using ViDA software, which was created by the International Road Assessment Programme (iRAP). Vehicle occupants, motorcycle riders, pedestrians and cyclists were the four categories of road users for which this safety rating was established. The study's objective 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.

Defective conditions were identified by the RSA, including improper sight distance at horizontal curves, dimly lighted built-up regions and median openings, absent pedestrian facilities, unlawful parking, construction debris discarded along the highway, 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 highway receives an average safety grade for motorcycle riders.

Sujata Basu and Pritam Saha (2022) The goal was to use innate cognitive mechanisms to study the problems on highways under a variety of roadway characteristics, such as pavement and shoulder width, their conditions, and highway accessibility, as well as mixed traffic situations that display a wide range of vehicle types in terms of statics and dynamics in their composition. This included temporal variability of the exogenous variable in terms of daytime and nighttime exposures on drivers' visibility.

According to the results, multilane highways with paved shoulders and good riding conditions had lower accident rates that are less affected by traffic volume. The majority of crashes are caused mostly by driving-related issues. The converse is true for two-lane highways when traffic volume has a significant impact on safety in addition to shoulder and pavement conditions. Platooning and entrapment of faster cars are rather typical because both directions utilise the same carriageway, especially when there is a higher volume of traffic in mixed-traffic conditions. In impatient drivers, risk-taking behaviour and dangerous manoeuvres are common. Differences in how different road users drive could create turbulence on the roadways and ultimately result in an accident. A crash could be caused, for example, by behaviours related to ageing, alcoholism, psychological stress, exhaustion, and obsessive behaviours.

V S Vinayaraj and Vedagiri Perumal (2022) intended to create a Safety Performance Function (SPF) model for evaluating the overall (intersection level) and approach level safety evaluation at roundabouts. Model formulation was done using data from crashes in 19 roundabouts with various traffic and geometry features. The State Crime Records Bureau provided the crash statistics for the five years from 2015 to 2019. Using a negative binomial model with a log-link function, an SPF model was created based on the roundabouts' design, traffic statistics, and crash rate.

In contrast, the number of circulatory lanes, inscribed circle diameter, and presence of road lane marking were negatively associated with the increased crash occurrences at roundabouts. The results showed that the percentage of PTW, percentage of heavy vehicles, average daily traffic at the junction, entry angle, and weaving length were all significantly associated with increased crash occurrences at roundabouts. The most important risk factor at both the roundabout intersection level and the entry approach level was

the average daily traffic. The way that some risk factors affect accidents varies greatly throughout developed SPF models.

Marko Subotic et.al (2021) Eight geometric-exploitation road criteria are used in the study to evaluate six measurement segments of a road network while accounting for light-goods vehicle data. A novel approach to determining the danger levels of road segments through assessment is put forth. To determine risk levels, the Measurement Alternatives and Ranking according to the Compromise Solution (MARCOS) approach was integrated with the Dombi Logarithmic Methodology of Additive Weights (D'LMAW). A hybrid approach based on the use of Dombi-Bonferroni functions and rough numbers was used to process statistical indicators. Six two-lane road sections' statistical metrics were processed in a real-world example to validate the effectiveness of the methodology. The sixth measurement segment performed the best since it posed the least amount of risk. It has been demonstrated that it is safer to measure sections with rising longitudinal gradients. The road speed deviation from the speed limit is decreased by the analysis of measuring sections from fall to rise. A sensitivity analysis was used to verify the efficacy, logic, and resilience of the suggested methodology's solution.

Jeena Johny A and Jisha Akkara (2019) concentrating on how alignment indices affect accident rates while considering the approach for assessing the safety and uniformity of two-lane rural highways using alignment indices. A set of criteria was created to assess the degree of protection, and mathematical models were used to quantify the impact of this alignment index on accidents.

The findings indicated that the most significant factors impacting accidents on horizontal curves were the ratio of curve length to tangent length, the ratio of curve length to road length, the average curve length, and the average tangent length. The evaluation of horizontal curves' geometric design consistency was derived from a comparison of design consistency evaluation models with respect to the chosen road segments and the number of accidents. Geometrical components of the road network need to be improved for underdeveloped areas.

Md Hasibul Islam et.al (2019) Investigating the impact of geometric design components on traffic accidents, including statistical models that have been employed over time, and comparing the findings of studies carried out in other nations were the goals of the study. However, some geometric design elements, like short sight distance and small curve radius, can significantly increase the rate and severity of road accidents. Understanding the relationship between road geometric design

elements and road accident rates is complicated by the interrelationships among the geometric design elements themselves as well as other accident-related factors. Furthermore, a combination of specific geometric design components may lead to the development of severe accidents.

Even though the results showed that lane width was more important to crash rates than shoulder width, several crash types—specifically, opposite-direction and run-off-road crashes—were reduced by increasing both lane and shoulder widths, but only to a limited extent. More lanes often result in fewer accidents; however, curves cause almost four times as many crashes as tangents. Wider shoulders may increase crash rates, however a shoulder width of up to 2.5 m has been proven to maintain safety. When traffic is uniform, horizontal curvature has a greater impact on accident rates than straight sections. This is especially true at radii under 200 meters, which correspond to an average operating speed of 90 kilometres per hour. In particular, graded horizontal bends significantly increase the likelihood of crashes. According to the results, downgrades have a much greater impact on the number of accidents than upgrades. Steep gradients have less of an impact on accidents than mild grades because they are typically shorter. However, compared to flat ground, accidents occur 30% more frequently in mountainous areas. The severity of accidents is lessened by median barriers, while head-on collisions are reduced by medians. Research on sight distance has found that sight distances under 0 m have a positive effect on crash rates but have minimal impact on safety.

Aakriti Gahlawat and Ranadip Mandal (2016) The research's goal was to use a road safety auditing approach to evaluate the Delhi-Rohtak Highway's potential safety issues and suggest feasible corrective treatment alternatives. Thirteen field trips were conducted in order to observe potential risks through the use of highway geometric studies, site-specific speed studies, vehicle and pedestrian counts, and other methods. Throughout the whole investigation, local traffic conditions were closely monitored.

The audit report recommended low-, mid-, and long-term remedial steps that were both inexpensive and expensive, based on the audit findings. Data on accidents was gathered from relevant police stations, examined, and compared to support audit conclusions and suggestions. Various design standards, drawings, road safety audit guidelines, and associated literature were studied in order to accomplish the research work's goals.

Dinesh Mohan et.al (2016) Data from fatal traffic accidents in six mid-sized Indian cities—Agra, Amritsar, Bhopal, Ludhiana, Vadodara, and Vishakhapatnam—were published in

the study. Car occupant fatalities range from 2% to 4%, TST occupants are less than 5%, and the percentage of vulnerable road user deaths in all six cities ranges from 84% to 93% of all road fatalities. The percentage of pedestrian fatalities linked to MTW collisions varies from 8% to 25% of the total, but collisions with buses and trucks account for the largest percentage of fatalities for all road user categories (particularly vulnerable road users), followed by collisions with cars.

The statistics show that, compared to their population share, the 0–14 age group is under-represented, including among kids who ride motorcycles. In comparison to autos, MTW and TST occupants have occupant fatality rates per 100,000 vehicles that are 2-3 and 3-5 times higher, respectively. Estimates of their correlation with fatal collisions, however, indicate that while TSTs offer a little lower risk to society, MTWs and cars present a comparable risk.

Mudit Mishra et.al (2014) aims to investigate the primary causes of accidents on the NH-22 route between Solan and Shimla. Using data gathered from multiple police stations in Kandaghat, Solan, and Shimla, black areas were identified. Poor visibility, rain and snow, a lack of SSD and OSD on curves, drivers' delayed reactions, nighttime traffic, headlight separation, tight turns, and a lack of experience driving on hilly terrain were the primary causes of accidents on the NH-22, according to data analysis of these black spots. Curiously, since this roadway was built before India gained its independence, no design specifications are available. Furthermore, for the past ten years, very nothing has changed on this section of the route (from Solan to Shimla). Nonetheless, in order to prevent accidents, careful consideration of driver safety must be given while keeping the safety of the passengers in mind. Convex mirrors, fluorescent sign boards, light poles, and, if feasible, retaining walls are some of the road furniture that the authors recommend be installed to lower the risk of accidents.

Kundan Meshram and H.S.Goliya (2013) analysed a small section of NH-3 Indore for accidents and presented it to Dhamnod. The analysis's data was gathered between 2009 and September 2011. The Manpur region saw an increase in accidents as a result of poor road geometry.

The findings showed that the urban area (Indore) had a trend of more than 35% of all accidents occurring there annually. Increased vehicle traffic and high speeds could be the cause of this. The section of the rural route has the highest recorded number of fatalities. Heavy movement of products heading into the city in the early hours from villages could be

the cause of this. There are very few accidents in cities that are caused by poor road geometry, and even fewer in rural highway sections. The research area experiences one fatality and five casualties per kilometre annually. With each passing year, the number of trucks using the study corridor increases. Since 2000, traffic has decreased in Rajendra Nagar as a result of the development of bypasses in the area.

III. CONCLUSION

As a output of literature review we can state that in past authors tried to describe the prone conditions where accidents can occur frequently.

REFERENCES

- [1] Md Izharul Haque, Amir Ali Khan, Gyanendra Singh, Sachin Dass and Saurabh Jaglan, [Accident analysis and road safety audit: a case study on NH-76], IOP Conf. Series: Earth and Environmental Science 1086 (2022) 012025.
- [2] Kundan Meshram and H.S. Goliya, [Accident Analysis on National Highway-3 Between Indore to Dhamnod], International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 2, Issue 7, July 2013 ISSN 2319-4847.
- [3] Marko Subotic, Veljko Radićević, Zoran Pavlovic and Goran Cirovic, [Development of a New Risk Assessment Methodology for Light Goods Vehicles on Two-Lane Road Sections], Symmetry 2021, 13, 1271. <https://doi.org/10.3390/sym13071271>.
- [4] Electricwala Fatima, Lokesh Gupta and Rakesh Kumar, [Exploratory Study for the Development of Road Safety Index on Indian Roads], Periodica Polytechnica Transportation Engineering, 52(1), pp. 96–103, 2024.
- [5] V S Vinayaraj and Vedagiri Perumal, [Safety evaluation of urban roundabouts in India: a safety performance function-based approach], Traffic Safety Research vol. 3 (2022) 000015.
- [6] Dinesh Mohan, Geetam Tiwari and Sudipto Mukherjee, [Urban traffic safety assessment: A case study of six Indian cities], IATSS Research 39 (2016) 95–101.
- [7] Mateen Ahemed and Dr. Sunil Sugandhi, [Road Safety Audit: A Detailed Analysis of Dhandhuka to Dholera (SH-20) in Gujrat State], International Journal for Research in Applied Science & Engineering Technology (IJRASET) ISSN: 2321-9653, Volume 11 Issue IX Sep 2023.
- [8] Aakriti Gahlawat and Ranadip Mandal, [Road Safety Analysis and Evaluation of Safety Risks of a Selected Section of Highway in India], International Journal of All Research Education and Scientific Methods (IJARESM) ISSN: 2455-6211, Volume 4, Issue 4, April- 2016.
- [9] Devesh Kumar and Deepak Mathur, [Evaluation of Road Safety Audit for Existing National Highway], International Journal of Recent Research and Review, Vol. XV, Issue 2, June 2022 ISSN 2277–8322.
- [10] Saurabh Kumar S and Sunil Sharma, [Measuring the Level of Road Safety through Road Safety Audit and Star Rating Method – A Case Study from Himalayan Expressway], IOP Conf. Series: Earth and Environmental Science 1084 (2022) 012044.
- [11] Ancy Genu C George, Abhirami K R, Anakha Haridas, Anusha Vinod and Divya K M, [Geometric Features of Road and Causes of Accident], International Research Journal of Engineering and Technology (IRJET), Volume: 09 Issue: 08 | Aug 2022, -ISSN: 2395-0072.