



ROAD ACCIDENT ANALYSIS – A CASE STUDY ON NATIONAL HIGHWAY

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Abstract: National highways and express ways play a crucial role in the development of states, but there is a pressing need for a road safety system to address this problem. Road traffic accidents have been identified as detrimental factors that hinder economic growth in developing countries due to their high associated costs, leading to social and economic concerns. Maharashtra, one of India's more advanced states, boasts a relatively dense road network and a higher concentration of motor vehicles compared to other states. The rapid growth of the population, coupled with increased economic development and motor vehicle usage, is a primary contributor to road accidents. To understand the scale of the problem within the state, it is common to correlate the number of road accidents and fatalities with demographic and vehicle statistics in Maharashtra's districts. Keywords relevant to this topic include Accident Causes, Black Spot Identification, and Analysis.

Index Terms – Road Safety, Accident Cause, Black Spot Identification, Analysis.

I. INTRODUCTION

The Mumbai-Agra National Highway (NH 3) has its origin in Chandwad, Nashik, but generally, it starts in Agra, Uttar Pradesh. It traverses southwest through various locations such as Dholpur in Rajasthan, Morena, Gwalior, Shivpuri, Guna, Biaora, Maksi, Dewas, Indore, and Julwani in Madhya Pradesh. Continuing further, it passes through Dhule, Malegaon, Nashik, Thane, and finally terminates in Mumbai. This highway includes a black spot known as Rahud Ghat, where accidents frequently occur. The primary causes of accidents in Rahud Ghat are carelessness, traffic rule violations, and poor road conditions. Curved road segments are particularly susceptible to traffic accidents due to their alignment characteristics, and crashes on curved segments account for 10% of the total number of traffic accidents and 13% of the total number of deaths. The rate of accidents in ghat sections in India is increasing, with 60,000 individuals estimated to be killed every year. Driving on ghat section roads poses significant risks and requires problem-solving techniques, advanced mathematics, statistical methods, data processing, understanding human factors, and knowledge of highway engineering. Road accidents are a major threat to public safety and economic development in India, particularly in Maharashtra, where the Mumbai-Agra National Highway (NH 3) serves as a vital link. To reduce the frequency and severity of road accidents, analysis of accident data is needed.

1.1. Causes of Road Accidents in Rahud Ghat:

Rahud Ghat, a black spot on the Mumbai-Agra National Highway (NH 3), is located close to Chandwad. Rahud Ghat, a hazardous section of this road, is where many accidents occur as a result of carelessness, violating traffic laws, and poor road conditions. Curved road segments are particularly prone to traffic accidents because of their alignment. For effective efforts to improve neighborhood road safety, these challenges must be identified.

Here is a thorough breakdown of the common reason's accidents happen on Rahud Ghat:

1. Nature Cause: Rahud Ghat, accidents can happen as a result of environmental variables like bad weather and reduced visibility brought on by rain and smoke. When it rains, the road surface may become slick, decreasing traction and raising the possibility of a car skidding out of control. It can also be challenging for drivers to see the road ahead, other cars, or other hazards owing to heavy rain or smoke, which can cause accidents.



Fig. Rahud Ghat

2. Due to vehicles: The majority of accidents are caused by flaws such brake, steering, tire, and lighting system failures, so vehicle owners and drivers should keep their vehicles in excellent condition.
3. Drink & Drive: Driving while intoxicated or under the influence of drugs is one of the major causes of accidents globally. Drivers who use drugs or alcohol have trouble focusing, reacting swiftly, and making good decisions. Due of this, accidents are far more likely to occur, especially on roads with a lot of turns and curves like Rahud Ghat.
4. Excess Speed: Driving too fast is another typical reason for accidents on Rahud Ghat. Drivers must exercise caution when navigating the road's steep turns and curves and must modify their speed accordingly. But when motorists go beyond the posted limit or drive too quickly for the conditions, they risk losing control of their cars and getting into collisions.
5. Bad Lighting: Accidents along Rahud Ghat can be exacerbated by inadequate or insufficient lighting, especially at night or in low light. It can be challenging for drivers to see the road ahead, recognize potential hazards, or precisely gauge the curvature of the road when there is insufficient lighting. Accident risk is increased by this poor visibility, especially on highways with tight turns and curves.
6. Overtaking: Overtaking may be difficult due to the road configuration of Rahud Ghat's tight bends and curves. However, some drivers might still do risky overtaking maneuvers, particularly if they are agitated or in a rush. Improper overtaking can result in collisions with approaching cars or even cars in front, which can lead to mishaps.
7. Distracted driving: The driver of an automobile needs pays close attention to the road in order to operate it safely. Drivers who lose focus, whether it be to use their mobile or send text messages to pals, end up endangering the lives of other drivers. Even if a slight distraction while driving might result in serious accidents. Driving while adjusting the mirrors is one type of distraction on the road. Vehicle radio or stereo, Animals on the highway.

1.2. Effects of Accidental in Rahud Ghat:

Everyone engaged in a traffic collision may suffer physical, monetary, and psychological consequences. Minor scrapes and bruises to broken limbs, whiplash, back and spinal injuries, paralysis, and even death can happen to drivers and passengers. Traffic accidents cause damage to vehicles, which may require cheap or expensive repairs or possibly totaling them and rendering them undrivable. Additionally, persons who are involved in or lose loved ones in traffic accidents may experience post-traumatic stress disorder (PTSD). This is one of the repercussions of traffic accidents.

1. Death and Injury: Aggressive drivers can direct their frustrations and rage on other road users by engaging in road rage. Unfortunately, innocent bystanders, pedestrians, and passengers are also injured or killed in the collision. A study by the AAA Foundation for Traffic Safety found that the 10,037 accidents it looked at resulted in at least 218 murders of men, women, and children and 12,610 injuries to other people. The report notes that among the 12,610 casualties were several instances of paralysis, brain damage, amputation, and other severely devastating injuries. When victims are unable to escape an aggressive driver's assault, they are typically thought of as accidental deaths.
2. Permanent Disability: When an accident prevents a person from performing particular occupational and/or non-occupational duties cognitively or physically for the remainder of their lives, it is considered a permanent disability. Even though a victim may not have constant physical discomfort, they may nevertheless have a chronic handicap that affects their capacity to do things. Some examples of permanent disabilities include:
 - a. Paralysis
 - b. Loss of Hearing/Sight
 - c. Loss of Mobility
 - d. Traumatic Brain Injury
 - e. Loss of Cognitive Abilities
 - f. Amputations

3. **Temporary Disability:** This is the case when you get a minor injury that is anticipated to temporarily handicap you before fully healing. Among the ailments that could temporarily disable a person include minor whiplash, broken bones, and strained muscles. You should seek lost income for the healing period as these injuries may prevent you from doing your job or the treatment may demand time off from work.

4. **Vehicular Damage:** If a car rear-ends you while you are stopped at a stop sign, that motorist is probably responsible for both the damage to your automobile and any injuries you sustain. But what if one of the following causes causes damage to your car or harm to you:

- a. Potholes
- b. Shoulder Drop-off
- c. Oil and Chip
- d. Construction Zone
- e. Icy or Snowy Roads
- f. Wet Roads

1.3. Methodology:

STEP-1: Once the Black Spot has been located, we gather information about it and do an accident analysis to determine how it occurred. One of the most crucial tasks in examining the accidental black spot is choosing the parameters. The parameters can be chosen from sources including reading articles from international journals, speaking with other drivers, and professional advice.

Obtain accident information: Obtain pertinent accident information from databases, police reports, insurance records, and medical records, among other sources. Make sure the data include facts on the affected vehicles, the state of the roads, the weather, the drivers, and any injuries.

Collect other information: Obtain more details on the condition of the roads, how they are used, the signs that are there, the posted speed limits, and any security film or eyewitness accounts that may be available.

STEP-2: Identify prevalent patterns, trends, and contributing factors related to accidents by analyzing the data that has been gathered. To quantify the relationships between variables, use statistical techniques.

Categorize accident causes: Sort accidents into categories based on their causes, such as external variables, road conditions, vehicle-related factors, or driver-related factors.

Identifying key factors that contribute to accidents and their severity can be done through correlation analyses or data visualization techniques. Natural accidents are caused by slope, road conditions, rain and smoke, while artificial accidents are caused by vehicle over speeding and drink & drive. Accidents include overturning, rear end collisions, right turn collisions and skidding.

1.4. Relevance of Project:

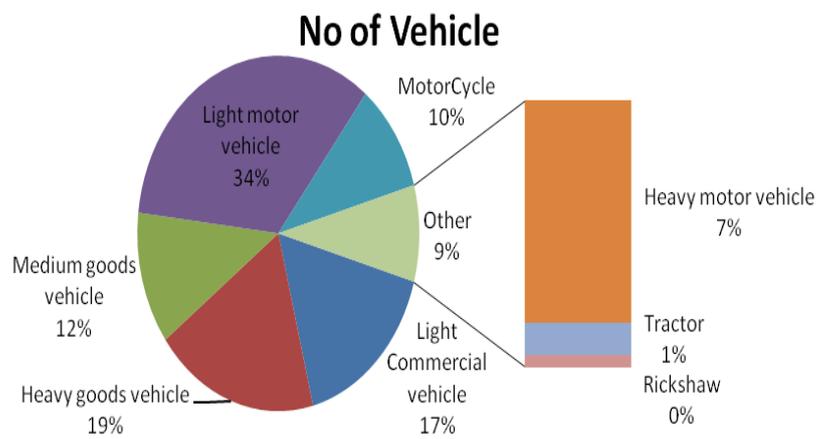
Analyzing road accidents in the ghat section, such as Rahud Ghat, through a case study has significant relevance due to its safety improvement, unique challenges, knowledge transfer, policy and planning, stakeholder engagement, and research and innovation. Ghat sections present unique challenges compared to straight roads, and understanding the specific factors contributing to accidents in ghat sections allows for tailored solutions. The findings of a case study can be applied to other similar areas or ghat sections, helping transportation authorities and policymakers make informed decisions regarding road design, safety measures, and traffic regulations in ghat sections across different locations. Stakeholder engagement can help decision-making processes be more inclusive and holistic, leading to better-informed and effective road safety initiatives.

II. DATA COLLECTION:

2.1. Vehicles Passed in One Hour:

We recorded data on November 18, 2022, at 12:00 PM, when 489 vehicles passed within an hour. Among them are a variety of vehicle types such light commercial vehicles, heavy trucks, medium-sized trucks, light cars, motorcycles, heavy cars, tractors, and rickshaws.

As Beside we have given Pie Chart of information containing Vehicle Passed in one Hour.



2.2. Speed of Vehicles in Rahud Ghat:

light-weight automobile: The average vehicle's speed in the ghat is 30 to 50 km/h, such as an Omini, Van, Maruti, Breeza, Innova, Swift, Tata Ace, Creta.

Medium goods vehicle: The average vehicle's speed in the ghat is 20 to 30 km/h, such as an Eicher, Tata 407, Pickup.

Heavy motor vehicle: The average vehicle's speed in the ghat is 10 to 15 km/h, such as an Bus, Ashok Leyland 18 Wheels, Tata truck, Private Bus, Container, Volvo Big container, Ashok Leyland.

2.3. Vehicle Data Taken from Vehicle Driver:

This different type of vehicle includes Tata Signa 5525, Tata Prima, AshokLeyland 4825, Ashok Leyland,Eicher, Swaraj manza, Ashok Leyland3718, Mahindra Benzo x55, Tata 4018.Tata 2518. Steel, metal sheet, machine, raw component, material, fruits, and clothing wood, Stones, Petrol, and Diesel are transported by the above-mentioned vehicle at a weight of around 8 to 10 tonnes kerb and 30 to 50 tonnes gross. This vehicle travels at a speed of about 10-15 km/hr.

2.4. Data Collected from SP Office:

We obtain data from the SP Office for the three years in which died in the accident on the Mumbai-Agra National Highway: 2019-55, 2020-61, and 2021-56.

III. ANALYSIS ON ACTUAL ACCIDENT

3.1. Case Study 1: On November 19, 2022

Two vehicles were involved in the accidents. The first was a TATA 3718c with the registration number UP 70 ET, a heavy goods vehicle (HGV) with a gross weight of 49 tonnes, and the second was a Maruti Suzuki Alto 800. Its registration number is MH 18 AJ 4721, and it is a light-duty vehicle (LMV).9 tonnes are its gross weight.



Fig. TATA 3718c



Fig. Maruti Suzuki Alto 800

We locate the TATA 3718c and Maruti Suzuki Alto 800 accidents during a live blackspot survey (UP 70 ET 9655 and MH 18 AJ 4721, respectively). The cause of this collision is a brake failure in vehicle 1, which struck vehicle 2's back side at a speed of 50 km/h despite vehicle 2's speed being 30 km/h. Then Vehicle 1 struck Barricade once more. Two somewhat mild injuries occurred.

3.2. Case Study 2: On November 21 2022

The crashes included three automobiles. Volvo bus G90, a heavy goods vehicle (HGV) with a gross weight of 35 tonnes, was the first. A Tata 3118 was the second vehicle its heavy goods vehicle (HGV) with a gross weight of 22 tonnes, The third is a large goods vehicle from Tata bus with a gross weight of 15 tonnes.



Fig. Volvo Bus G90



Fig. TATA 3118



Fig. TATA 3118

During a live blackspot survey, we were able to locate the Volvo bus G900 and TATA 3118 accidents. The driver of vehicle 1 was sleeping when the accident occurred, and vehicle 1 struck vehicle 2 at a speed of 70 km/h on its left side while moving at a speed of 40 km/h.

The rear side of vehicle 2 was then struck once more. Then Vehicle 1 struck Barricade once more. Moreover, vehicle 1 loses control and crashes into a barricade.

IV. SOLUTIONS TO REDUCE SPEED AND ACCIDENTS

For better safety and vehicle performance, reducing friction on ghat sections—steep, curving mountain roads—is crucial. The following are some possible ways to lessen friction on ghat parts.

1. **Regular Maintenance:** In order to reduce friction, it is crucial to ensure routine road maintenance. Potholes, fissures, and uneven surfaces that can increase friction and make driving dangerous must be filled in as of this.
2. **Surface Treatment:** The friction properties of the road can be improved by applying surface treatments like asphalt overlays or high-friction surface coatings. These modifications improve tire grip and lessen sliding, especially in slick or rainy situations.
3. **Banking and Cambering:** The stability of the vehicle can be improved and lateral forces acting on the tires can be reduced by properly banking and cambering road curves. While driving on ghat parts, this design element reduces the possibility of skidding and enhances overall control.
4. **Guardrails and Rolling Barriers:** Guardrails and barriers can be put in place to add more safety precautions along the ghat sections. In the event of an accident, these features aid in preventing vehicles from deviating off the road, decreasing the likelihood of friction-causing crashes.
5. **Signage and Road Markings:** Road markings and clear signs are essential for directing traffic along ghat parts. Drivers can alter their speed and maneuver more safely when warning signs for approaching curves, steep hills, and other possible hazards are present.
6. **Speed Limits and Speed Cameras:** Implementing speed limits and speed cameras in ghat sections can be effective solutions for reducing accidents. Speed limits should be tailored to the challenging terrain and road conditions, and signage should be prominently displayed. Speed cameras should be installed at strategic locations along ghat sections to monitor and enforce speed limits. Publicizing the presence of speed cameras through signage and awareness campaigns can create a culture of compliance with speed limits.
7. **Vehicle Checks:** Regular vehicle maintenance inspections can help find and fix problems that could affect friction, especially before travelling over ghat areas. For maximum grip and to prevent skidding, adequate tire tread depth, proper tire inflation, and working brakes are essential.
8. **Speed Guns:** In order to monitor and enforce speed limits, ghat sections frequently use speed guns, also known as radar guns. Road segments known as "ghats" frequently occur in hilly or mountainous terrain and feature steep slopes or abrupt turns. Due to the terrain, these sections can be difficult to drive through, and speeding puts other road users and motorists at serious risk.
9. In ghat sections, speed guns are used to make sure that drivers maintain a safe and appropriate speed while negotiating the difficult road conditions. Speeding in ghat areas can result in collisions, loss of control, and longer stopping distances, endangering the lives of motorists, passengers, and other people. Radar technology is used in speed guns to measure the speed.
10. **3D Zebra Crossing:** A 3D zebra crossing is a road safety measure designed to reduce speed and enhance pedestrian safety. It is created by using contrasting colors, shading, and perspective techniques to create an optical illusion that grabs the attention of drivers and pedestrians. The main objective is to create a visual deterrent for speeding vehicles and provide a safer environment for pedestrians to cross the road. 3D zebra crossings are typically created using non-toxic, eco-friendly paint that is durable and resistant to weather conditions. Driver education is important to ensure drivers understand the intended safety benefits and respect the crossing.
11. **Avoid distraction:** The driver should always give out most attention while driving. They should avoid loud music in cars and also should avoid headphones. The co-passengers should avoid distracting the driver.
12. **Awareness:** Promoting awareness is essential for reducing accidents in ghat sections. Collaborating with authorities and engaging local communities are key to fostering a culture of responsible driving. Through comprehensive awareness campaigns, we have the potential to significantly decrease accidents and establish safer ghat sections. Sustained efforts to prioritize awareness and education will pave the way for a more secure transportation network.

V. CONCLUSION

Because traffic accidents are terrible for everyone and are on the rise, everyone has to understand this and focus more on reducing the number of them. Therefore, the necessity of the hour is for road safety education. As a result, there are numerous reasons why traffic accidents occur. Therefore, there is an obvious need for road safety education, which should be provided to those road users who are regularly hurt in accidents.

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