

Causes of Accident and Effective Measure to Improve Road Safety

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Abstract: Road accidents have a significant impact on the development of civilizations and economic growth, resulting in substantial economic losses and loss of life. Identifying the factors contributing to these accidents is crucial for implementing measures to reduce their occurrence and improve road safety. This study aims to identify the causes of road accidents in order to develop effective strategies for accident prevention. By conducting a thorough analysis, the root causes of accidents can be identified, leading to the implementation of appropriate remedial measures to enhance the performance of highways. Additionally, a "Benefit to Cost Ratio" (BCR) analysis will be conducted for each proposed infrastructure safety measure, enabling the prioritization of their implementation based on the potential number of lives that can be saved within the available budget. The Mumbai Pune Expressways 94.6 km long and 6-lane roadway, plays a vital role in reducing travel time between the two cities. With a speed limit of 80 km/h for most parts of the stretch, the expressway restricts the usage of two-wheelers and three-wheelers. Common vehicle types observed on the expressway include cars, trucks, and buses. Despite its significance, the expressway experiences a high number of traffic crashes, fatalities, and serious injuries, emphasizing the need for comprehensive measures to enhance safety.

Keywords: Road accidents

I. INTRODUCTION

1.1 General

The general focus of your project is on the importance of the road network in the economic and social development of a country, specifically India, with a special emphasis on Maharashtra. The project aims to identify the causes and contributing factors of accidents and develop effective remedial measures to prevent and mitigate the consequences of accidents.

The significance of road transportation in India cannot be overstated, as it serves as the primary mode of transportation with extensive coverage and the ability to provide convenient door-to-door service.. However, the increase in population and the corresponding rise in the number of vehicles have led to a higher incidence of accidents, obstructing economic and social development.

To address this issue, the project seeks to study and identify accident-prone zones on highways and implement measures to reduce accidents. By conducting hazard assessments, implementing safety procedures, and providing employee training programs, the project aims to create a safer workplace and environment. The ultimate goal is to reduce accidents and their adverse impacts, including injuries, fatalities, property damage, and financial losses.

The project recognizes Maharashtra's role as a rapidly growing state, attributing its development to a well-developed road network that enables efficient transportation. However, with the increasing number of vehicles, it is crucial to address the issue of accidents to ensure sustained progress. By identifying accident-prone zones and implementing remedial measures, the project aims to enhance road safety and facilitate the overall economic and social development of the region.

By taking proactive steps to reduce accidents and providing effective remedial measures, your project aims to create a safer road network, minimize the consequences of accidents, and contribute to the overall progress of the area.

1.2 Aim

The aim of this study is to adopt a multifaceted approach to road safety by focusing on areas with a high incidence of accidents. The primary objective is to identify the underlying causes of these accidents and implement effective measures to reduce their frequency and enhance overall road safety. Additionally, the study aims to evaluate the economic benefits and costs associated with proposed construction projects in order to make informed decisions. By considering both the financial implications and potential advantages, the government can ensure the efficient allocation of resources and maximize the overall impact of road safety initiative

1.3 Objective of the Work

1. Identify the infrastructure factors that contribute to accidents and injuries on the road in general.
2. Quantify the occurrence of these infrastructure factors along the entire stretch of the Pune-Mumbai NH48 , either in terms of counts or kilometers covered.
3. Determine appropriate safety measures that can effectively mitigate the impact of these infrastructure factors, leading to a reduction in accidents and injuries.
4. Prioritize the implementation of the identified safety measures by conducting a Benefit to Cost Ratio (BCR) Analysis.
5. Regression analysis: The aim is to estimate value of constants from the data collected through multivariable linear regression analysis in regression equation.

1.4 Scope of the Work

1. With the advent of technology and advanced algorithms to manage the traffic flows and integrate the analysis of the accidents.
2. It would be possible to apply machine learning algorithms to determine the most probable black spots by analysing the real time
3. Accident conditions and provide the safest and most comfortable safety environment. As the population is rising, there will be a corresponding rise in the accident related issues, to counter the evil effects of the black spots.

1.5 Limitations

- Time Limitations: The study may be constrained by a limited timeframe, which can affect the data collection process and the depth of analysis. The availability of resources and the ability to gather comprehensive data within the given timeframe may pose challenges.
- Difficulty in Identifying Root Causes: Identifying the root causes of accidents and accurately analyzing the contributing factors can be a complex task. Factors such as human behavior, weather conditions, and road design can all play a role in accidents. It may be challenging to isolate and address each contributing factor effectively.
- Data Availability: The availability and completeness of accident data may pose challenges during the research process. Incomplete or unavailable data can hinder the analysis and the development of effective solutions. Dependence on existing data sources and their reliability can impact the accuracy of the findings.

II. DATA COLLECTION

2.1 General

In this data collection, the information is related to the various types of accident as mentioned in various research paper, infrastructure development groups, internet, etc. These various types of accidents give idea about it and how those types of accidents are absolutely caused.

In the following table, number of accidents related the information the with the information of grievous injury, minor injury, no injury, numbers of fatal and number of total accidents that happened.

2.2 Various types of Accident

- Stopping sight distance
- Extra widening
- Signal cycle length ,etc

The infrastructure factors that contribute to accidents and injuries on the Mumbai-Pune Expressway.

1. Narrow/No shoulder
2. Roadside/Median concrete structure
3. Poor/ineffective road signage
4. Roadside steep slope/drop-off
5. Sharp Road curvatures
6. Curb stones

III. METHODOLOGY

Video survey

Conduct a systematic video survey of the Mumbai-Pune Expressway, covering the entire stretch.

Use cameras to capture footage of the road infrastructure, including road conditions, signage, barriers, lane markings, and other relevant features.

Ensure consistent and accurate documentation of the surveyed areas.

Determination of infrastructure factors

Analyze the collected video data to identify infrastructure factors that influence accidents and injuries.

Focus on factors such as sharp curves, inadequate signage, poor road surface conditions, insufficient lighting, narrow shoulders, and any other factors observed in the survey.

Create a comprehensive list of these infrastructure factors for further analysis.

Road side interview

During the roadside interviews, data was collected from diverse participants representing various types of vehicles, including cars, buses, trucks, and motorcycles.

Structured questionnaires were utilized to ensure consistent data collection, allowing for an exploration of their perceptions, experiences, and suggestions concerning the identified infrastructure factors. Participants shared their observations and concerns related to factors such as sharp curves, inadequate signage, poor road surface conditions, insufficient lighting, and narrow shoulders.

Their valuable insights and suggestions contributed to a comprehensive understanding of the road safety challenges faced by different vehicle categories, aiding in the development of targeted and effective remedial measures. Providing suitable safety measures that can mitigate the effects of these infrastructure factors.

below are the questions which we are going to ask them with traffic police permission.

Q.1) Have you ever witnessed or been involved in a hit-and-run accident on the Pune-Mumbai National Highway?

Q.2) In your opinion, what are the most common causes of car accidents on the Pune-Mumbai National Highway?

Q.3) Have you noticed any patterns or trends in the types of car accidents that occur on the Pune-Mumbai National Highway?

Q.4) What do you think can be done to improve road safety on the Pune-Mumbai National Highway?

Q.5) Do you think that the use of mobile phones while driving is a significant contributor to car accidents on the Pune-Mumbai National Highway?

Q.6) Have you noticed any particularly dangerous sections or stretches of road on the Pune-Mumbai National Highway where accidents are more likely to occur?

Q.7) Have you noticed any particular challenges for drivers during rainy season on the Pune-Mumbai National Highway?

Q.8) How can emergency response be improved in case of an accident on the Pune-Mumbai National Highway?

Q.9) What steps do you think should be taken to ensure that commercial vehicles are maintained and operated safely on the Pune-Mumbai National Highway?

Q.10) Have you listened to any music while driving?

Providing Suitable Safety Measures:

- Analyses the collected data from the video survey and roadside interviews to determine appropriate safety measures.
- Consult relevant guidelines, best practices, and expert opinions to identify effective remedial measures for each infrastructure factor.
- Consider measures such as improved signage placement and visibility, road surface repairs and enhancements, installation of barriers and guardrails, widening of shoulders, and implementation of advanced warning systems.
- Develop a detailed plan for implementing these safety measures, including cost estimates, timelines, and potential challenges.

Calculation of Benefit to Cost Ratio of recommended safety measures

- Conduct a Benefit to Cost Ratio (BCR) analysis for the recommended safety measures.
- Evaluate the potential benefits of each measure, such as reduced accidents, injuries, and fatalities, improved traffic flow, and economic savings.
- Estimate the costs associated with implementing each measure, including materials, labour, and maintenance (Based on already available solutions applied around the world for similar safety issues). The cost of installation of these safety measures were determined based on enquiries with individuals and agencies involved in such road safety work.
- Prioritize the implementation of safety measures based on their BCR values, giving higher priority to measures with a higher BCR, indicating a greater cost-effectiveness.

Location

We decided that the survey should be carried out on the Mumbai-Pune Expressway, popularly known as the Yashwant Rao Chavan Expressway, given its status as India's pioneering 6-lane tolled expressway. This remarkable 6-lane tolled expressway spans a distance of 94.5 kilometers, connecting the bustling capital city of Maharashtra, Mumbai, with the vibrant cultural and educational hub, Pune. Ever since its complete operationalization in 2002, the Mumbai-Pune Expressway has revolutionized automobile transportation in India, setting new benchmarks for speed and safety. As one of the busiest thoroughfares in the country, this expressway presented an ideal location to gather pertinent data, enabling the identification of critical infrastructure factors and the formulation of effective remedial measures aimed at enhancing road safety.

Causes of Accident

Adverse weather conditions such as fog during the rainy and winter seasons significantly reduce visibility on the Mumbai-Pune Expressway, making it difficult for drivers to see the vehicles in front of them. This limited visibility becomes a major cause of accidents. Additionally, overspeeding and reckless driving practices contribute to a high number of injuries and fatalities as vehicles collide with each other. These factors highlight the importance of promoting responsible driving behavior to prevent accidents and save lives.

Another significant factor leading to accidents on the expressway is the absence of barriers in certain locations, which increases the risk of vehicles veering off the lanes and causing accidents. The lack of protective barriers puts drivers and passengers at a higher risk of severe injuries or even fatalities.

To gain a comprehensive understanding of the accident causes, extensive research and analysis were conducted, and data from the Regional Transport Office (RTO) covering several years was collected. The analysis revealed a substantial number of accidents occurring on the Mumbai-Pune Expressway during this period. This emphasizes the urgent need for effective countermeasures and safety enhancements to reduce accidents and improve overall road safety.

IV. RESULT

This paper presents compelling results demonstrating the significant impact of addressing key factors contributing to accidents in a specific sequence: Narrow/No shoulder, Roadside/Median concrete structure, Poor/ineffective road signage, Roadside steep slope/drop-off, Sharp Road curvatures, and Curb stones. By strategically addressing these factors in the proposed sequence, the study reveals the potential for substantial economic benefits and enhanced road safety. The findings underscore the importance of prioritizing and implementing targeted interventions to mitigate accident risks and optimize the utilization of resources.

V. CONCLUSIONS

Based on the identification of the infrastructure factors that influence the occurrence of road accidents and injuries, quantifying their occurrence on the Mumbai-Pune Expressway, and determination of Benefit to Cost Ratio (BCR) for implementing the safety measures to mitigate accidents and injuries that are influenced by these infrastructure factors, the following conclusions can be drawn:

In general we found out causes and effective measures to reduce accidents. Some causes are given below

Stopping sight distance

Extra widening

Signal cycle length

Identified Factors which causes accident on punemumbai highway

1. Narrow/No shoulder
2. Roadside/Median concrete structure
3. Poor/ineffective road signage
4. Roadside steep slope/drop-off
5. Sharp Road curvatures
6. Curb stones

Provide effective measures

Economical suggestion

Infrastructure Factor (and Safety Measure)	Order priority
Narrow/No shoulder (Widening of shoulders (where possible))	1
Roadside/Median concrete structure (Installation of impact attenuators (water/sand filled barrels))	2
Poor/ineffective road signage (Installation of effective road signage)	3
Roadside steep slope/drop-off (Installation of guardrail/wire rope safety barrier extension)	4
Sharp road curvatures (Installation of adequate advance warning signage)	5
Curb stones (Removal of curb stones)	6

Regression analysis:- The estimated value of constants from the data collected through multivariable linear regression analysis in regression equation is

$$NOA = 0.269 + 0.756 \text{ Sholder} + 1.2368 \text{ Median} + 1.1578 \text{ Signage} + 1.0992 \text{ steep slope} + 1.0087 \text{ Sharp Road curvatures}$$

REFERENCES

[1] https://en.wikipedia.org/wiki/Accident_blackspot
 [2] <https://nhai.gov.in/#/black-spots>
 [3] <https://morth.nic.in/>
 [4] IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)
 [5] Road Safety - Engineering interventions & Black spot rectification Ravi Prasad Chief Engineer (Road Safety) Ministry of Road Transport & Highways, Government of India.
 [6] Rectification of Accident Black Spot - Preparation of proposal and sanction/approval memorandum of MORTH.

[7]International Journal Of Creative Research Thought (IJCRT) 1Shailendra Singh, Shivam Singh Patel M.Tech Student (Highway Engineering), Assistant Professo Department of Civil Engineering Maharishi University, Lucknow, India

[8]Accident Analysis At The Black Spot: A Case Study November 2015IOSR Journal of Mechanical and Civil Engineering 12(6):105-114 DOI:10.9790/1684-1262105114.

[9]<https://www.irjet.net/archives/V10/i4/IRJET-V10I487.pdf>