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HIGH-SPEED INFRASTRUCTURE AND HUMAN ERROR: AN ANALYSIS OF ACCIDENTS ON THE MAHARASHTRA SAMRUDDHI EXPRESSWAY

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ABSTRACT

The main objective of this paper is to investigate the relationship between high-speed infrastructure and human error on the Maharashtra Samruddhi Expressway). The accident data from 2023 and provisional data from 2024, this paper attempts to analyze fatal, serious and minor accidents, briefly examine trends and trace possible causes. The paper aims to identify areas for improvement in road safety and suggest comprehensive solutions for a sustainable high-speed transport system. The Maharashtra Samruddhi expressway is high-speed expressway connecting Mumbai and Nagpur, is an important project that shows progress in infrastructure in Maharashtra as well as India. Although the expressway is made using modern designed and constructed using stringent safety standards, the expressway has been plagued by a number of accidents since its operation mode. It focuses on the correlation between human error and high-speed infrastructure. The analysis of accident reports, traffic data, and ground observations has shown that over speeding, driver fatigue, and non-compliance with lane discipline are the main causes of incidents on the expressway (Maharashtra State Road Development Corporation [MSRDC], 2023).

At the same time, research identifies gaps in driver training and awareness of high-speed driving protocols as important factors. It also explores how current infrastructure, such as inadequate signage and limited emergency response units in certain areas, can exacerbate the effects of human error (Indian Road Safety Mission, 2022). The study highlights future solutions, including stricter enforcement of traffic rules, improved driver training, and adaptive safety measures for high-speed corridors. The study contributes to the broader discussion on road safety in developing countries, emphasizing the need to synchronize human behaviour with technological advances in transport infrastructure.

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INTRODUCTION

The rapid expansion and development of the expressway network in a developing country like India is indicative of the development in transportation and infrastructure. Maharashtra Samruddhi Mahamarg (Hindu Hridaysamrat Balasaheb Thackeray Maharashtra Samruddhi Mahamarg), is a major project connecting the major metropolises of Nagpur and Mumbai in Maharashtra, which will provide high-speed travel facilities across Maharashtra. The expressway, which is approximately 701 km long, will significantly reduce travel time, but it is also creating road safety issues. Human error is a major factor in road accidents, especially in high-speed environments.

The Mumbai-Nagpur Expressway connects 10 major districts directly and 14 districts indirectly through feeder roads and passes through 24 tehsils and 392 villages. The 10 major districts on expressway are Nagpur, Wardha, Amravati, Washim, Buldhana, Jalna, Aurangabad, Nashik, Ahmednagar and Thane. The Mumbai-Nagpur Expressway is being constructed by the Maharashtra State Road Development Corporation (MSRDC) With the alignment connecting Shivmadka village in Nagpur district to Amne village in Bhiwandi city in Thane district. The total project cost including land acquisition cost is around ₹55,000 crore.

LITERATURE REVIEW

The Samruddhi Mahamarg Expressway, a high-speed corridor connecting Nagpur and Mumbai, was inaugurated in phases starting from December 2022. While the expressway aims to enhance regional connectivity and reduce travel time, it has also become a hotspot for road accidents in its initial months of operation. According to a report by Business Standard (2023), between December 11, 2022, and April 30, 2023, the expressway recorded 358 accidents, leading to 39 deaths and 143 injuries. This number increased sharply over the months, with The Indian Express (2023) reporting 624 accidents and 92 fatalities by July 2023. Further, The Times of India (2023) noted that by mid-2023, over 1,000 accidents had occurred on the expressway, resulting in 106 deaths.

Several causes have been identified for this alarming trend. A study conducted by the Visvesvaraya National Institute of Technology (VNIT) revealed that driver fatigue and sleepiness were leading causes of accidents. The expressway's long, straight, and monotonous stretches contribute to "highway hypnosis" a trance-like state where drivers lose focus while driving (Hindustan Times, 2023). This finding is further supported by Swarajya Magazine (2023), which highlighted that highway hypnosis is a serious issue on uniform, distraction-free expressways like Samruddhi.

Over-speeding is another major factor. Data from The Indian Express (2023) showed that over-speeding led to 18 fatal accidents and caused 29 deaths in the early months of operation. Additionally, tyre bursts due to high speeds and prolonged driving were identified as a recurring cause of accidents (Hindustan Times, 2023). Improper tyre maintenance and heat-induced tyre

failure on long drives were common contributing issues.

In response, the Maharashtra State Road Development Corporation (MSRDC) has implemented several safety measures. These include installing colourful flags on the median to visually break monotony, rumble strips every 25 kilometres to alert drowsy drivers, and improved signage to encourage breaks (Mid-Day, 2023). Awareness programs have also been introduced to educate drivers on the risks of fatigue, the importance of taking breaks, and maintaining vehicle health, especially tyres.

AIM OF STUDY

The primary aim of this study is to analyze the causes and patterns of road accidents on the Maharashtra Samruddhi Expressway, with a special focus on the intersection between high-speed infrastructure and human error. While the expressway represents a modern engineering marvel designed for high-speed travel, the rising number of accidents since its inauguration highlights critical issues in driver behaviour, road safety awareness, and infrastructure adaptation.

OBJECTIVE OF STUDY

1. To study the change in accident severity between 2023 and 2024.
2. To assess the impact of road safety measures on accident trends.
3. To analyze the relationship between accident type and injury outcome.

STUDY AREA

The present study focuses on the Samruddhi Mahamarg Expressway, officially known as the Hindu Hrudaysamarat Balasaheb Thackeray Maharashtra Samruddhi Mahamarg. This high-speed, access-controlled expressway spans approximately 701 kilometres, connecting Nagpur in eastern Maharashtra to Mumbai in the west. Designed to significantly reduce travel time to about sixteen hours to eight hours, the expressway represents one of the most ambitious and transformative infrastructure projects undertaken by the Government of Maharashtra. The route traverses through 10 major districts, including Nagpur, Wardha, Amravati, Washim, Buldhana, Jalna, Aurangabad (Chatrapati Sambhajinager), Nashik, Ahmednagar, and Thane, impacting more than 392 villages and 26 tehsil along its path.

Strategically, the expressway is envisioned as not just a transport corridor but a catalyst for economic development. It includes provisions for growth centres, logistics hubs, agro-industrial zones, and IT parks, with the aim of decentralizing urban pressure and boosting regional connectivity. Key cities such as Nagpur, Aurangabad, Nashik, and Thane are directly connected, making it a lifeline for trade and mobility within Maharashtra. However, the expressway has also attracted attention due to a rising number of road accidents since its partial opening in December 2022. Factors such as over-speeding, driver fatigue, and highway hypnosis have been identified as major contributors to these incidents.

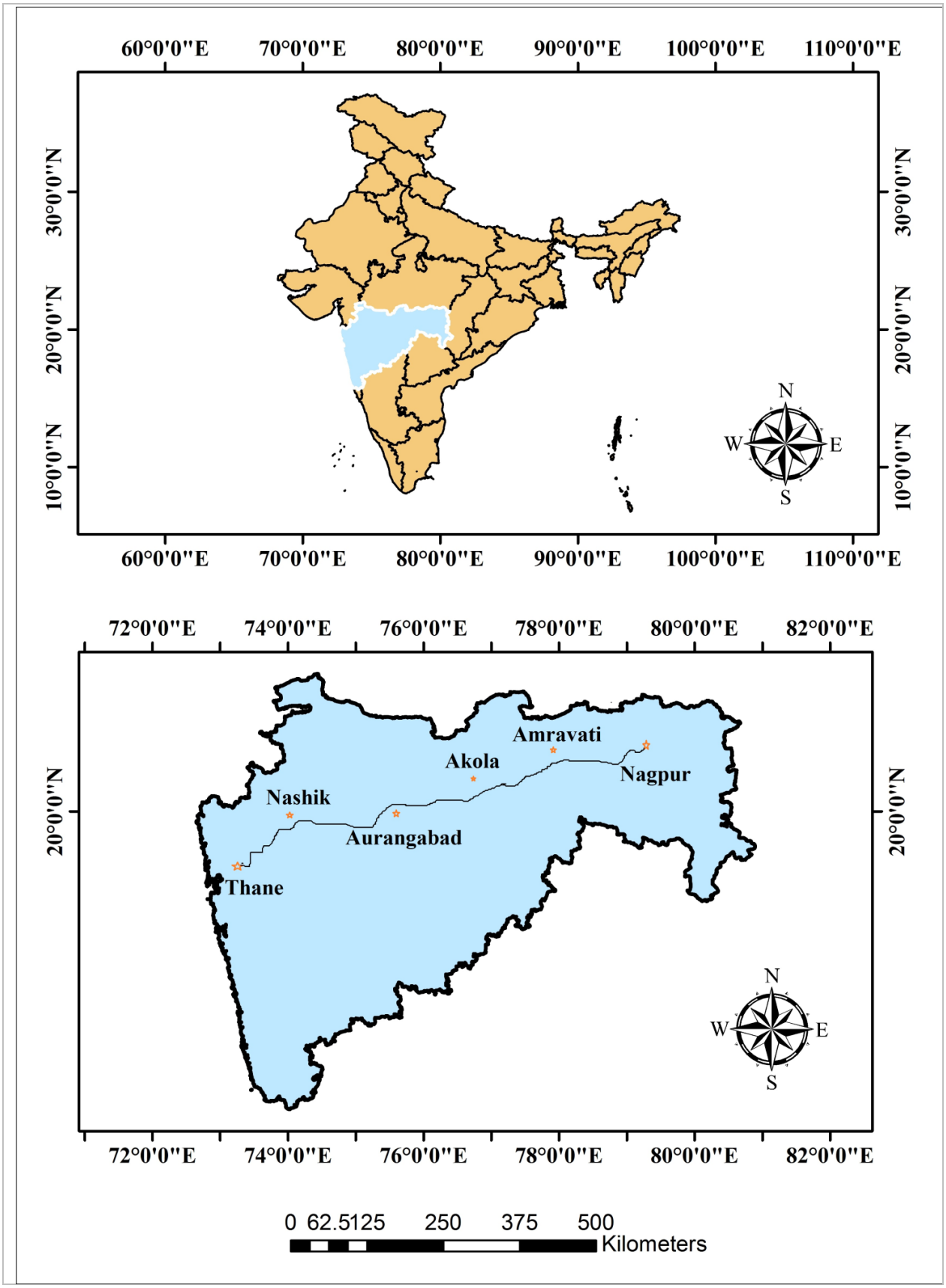
Table No. 1

Samruddhi Mahamarg (Mumbai–Nagpur Expressway) – Detailed Overview

Category	Parameter	Details
General Information	Official Name	Hindu Hrudaysamarat Balasaheb Thackeray Maharashtra Samruddhi Mahamarg
	Popular Name	Samruddhi Expressway
	Type	Greenfield, Access-Controlled Expressway
	Total Length	Approximately 701 kilometers
	Connecting Cities	Nagpur (East) to Mumbai (West – Thane district)
	Number of Lanes	6 lanes (expandable to 8 lanes)
	Design Speed	80 km/h to 120 km/h
	Construction Agency	Maharashtra State Road Development Corporation (MSRDC)
	Estimated Cost	₹55,000 crores (approx.)
	Foundation Stone Laid	December -2018
	Partial Inauguration	December 11, 2022 (Nagpur–Shirdi stretch)
	Full Operation	Mid 2025
Geographical Information	Districts Covered (10)	Nagpur, Wardha, Amravati, Washim, Buldhana, Jalna, Aurangabad (CSN), Nashik, Ahilyanager and Thane
	Terrain	Mixed terrain: plains, semi-arid, hilly (Nashik-Aurangabad), forest patches
	Climate Zones Crossed	Tropical wet and dry, semi-arid, and humid coastal
	River Crossings	26 rivers and over 300 streams bridged
	Land Acquisition Area	20,000 hectares approx.
	Environment Impact	Afforestation initiatives, noise barriers, wildlife underpasses in place
Socio-Economic Information	Villages Impacted	392 villages across 26 tehsils
	Employment Generated	Over 35,000 jobs (direct & indirect) during construction
	Industrial & Growth Centers	24 nodes planned along the route (logistics, agro-processing, manufacturing)
	Economic Benefits	Boosts connectivity for MSMEs, Tourism, agriculture
	Travel Time Reduction	Nagpur–Mumbai travel reduced from 16 hours to 8 hours
	Regional Development	Promotes decentralization of urban growth, access to rural markets
	Social Impact	Improves access to education, health, jobs
Safety & Smart Features	Safety Installations	Crash barriers, fencing, rumble strips, median alert flags
	Monitoring System	Intelligent Traffic Management System (ITMS), CCTV surveillance
	Amenities	Fuel stations, rest areas, food courts, ambulance, Police van

Figure No. 2

LOCATION MAP OF STUDY AREA



DATABASE AND METHODOLOGY

This study uses Category wise accident data on Samruddhi Expressway descriptive statistical analysis to compare accident figures from 2023 and provisional data from January to November 2024, sourced from https://highwaypolice.maharashtra.gov.in/statistics/ police records monitoring the Samruddhi Expressway. Data are categorized into Fatal Accidents, Serious Injury Accidents and Minor Injury Accidents without Injuries a comparative analysis and graphical visualization were carried out to identify patterns and trends.

DISCUSSION

The data presented shows a mixed but generally positive trend in road accident statistics between 2023 and 2024 (provisional). Fatal accidents saw a slight decline of 2%, dropping from 81 in 2023 to 79 in 2024. the number of fatalities decreased significantly by 29%, from 151 to 107, which suggests that although the number of severe accidents remained similar, their outcomes were less deadly possibly due to improved medical response, better road safety measures, or advancements in vehicle safety features. on the other hand, accidents resulting in serious injuries increased by 35%, and the number of seriously injured persons rise by 19%. This indicates a rise in high-impact incidents that, while not fatal, still result in major injuries. It could point to a need for greater focus on preventing such types of accidents or addressing their underlying causes.

Table No. 2

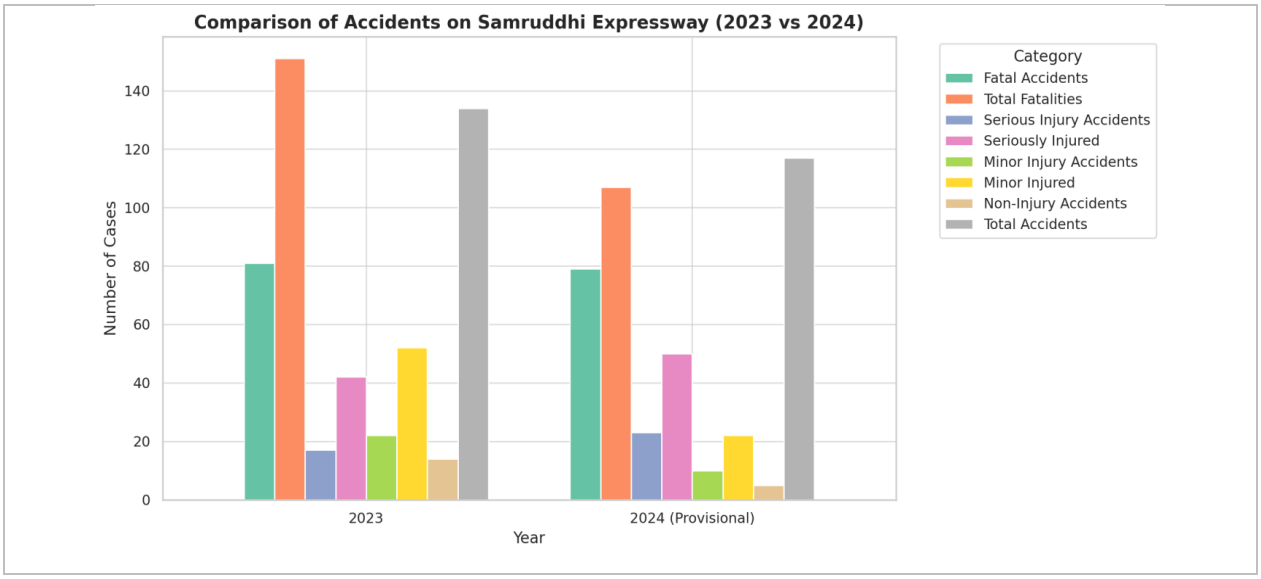
CATEGORY WISE ACCIDENT ON SAMRUDDHI EXPRESSWAY

Category / Year	2023	2024 (Provisional)	% Change (2023-24)	Total (2023+2024)
Fatal Accidents				
No. of Accidents	81	79	-2%	160
Total Killed	151	107	-29%	258
Seriously Injured Accidents				
No. of Accidents	17	23	35%	40
Total Seriously Injured	42	50	19%	92
Minor Injury Accidents				
No. of Accidents	22	10	-55%	32
Total Minor Injured	52	22	-58%	74
Without Injury Accidents	14	5	-64%	19
Total Accidents	134	117	-13%	251

(**Source**: https://highwaypolice.maharashtra.gov.in/statistics/)

Figure No. 2

COMPARISON OF ACCIDENTS ON SAMRUDDHI EXPRESSWAY



(**Source**: Computed by Researcher)

Minor injury accidents showed a sharp decline of 55%, and the number of people with minor injuries dropped by 58%. Similarly, non-injury accidents fell by 64%. These trends may reflect improved road discipline, reduced traffic volumes in certain areas, or changes in how accidents are reported or categorized. Overall, total accidents decreased by 13%, from 134 in 2023 to 117 in 2024. This indicates a general improvement in road safety conditions. In conclusion, while the reduction in fatalities and total accidents is a strong positive indicator, the increase in serious injuries highlights the need for continued efforts in road safety awareness, infrastructure improvements, and emergency preparedness. The data suggests that the measures taken so far are having an impact, but there is still work to be done to further reduce the severity and frequency of accidents.

CONCLUSION

The analysis of road accident data from 2023 to provisional figures for 2024 indicates an overall improvement in road safety. Fatal accidents have slightly decreased, and there has been a significant 29% reduction in fatalities, suggesting better survival outcomes due to improved emergency response or vehicle safety standards. Total accidents have also declined by 13%, reflecting positive progress in accident prevention efforts.

However, there is a noticeable increase in accidents involving serious injuries (up 35%) and the number of seriously injured individuals (up 19%), which highlights an area of concern. At the same time, both minor injury accidents and non-injury accidents have shown substantial declines, which may indicate better traffic discipline or changes in reporting trends.

RECOMMENDATIONS

To enhance safety and minimize the impact of human error on high-speed corridors such as the Samruddhi Expressway, the study suggests the following measures.

Sr. No.	Area	Recommendation
1	Serious Injuries	Enforce stricter rules for speed limits, and seatbelt usage.
2	Road Infrastructure	Improve road design, signage, lighting, and maintenance in accident-prone zones.
3	Emergency Response	Strengthen emergency medical and Police services for faster and more effective accident care.
4	Public Awareness	Conduct regular road safety campaigns to promote responsible driving behavior.
5	Data Monitoring & Reporting	Ensure accurate, consistent reporting of all types of accidents.
6	Technology Integration	Promote use of ADAS (Advanced Driver-Assistance Systems) in vehicles and implement smart traffic systems.

PHOTO



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