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Study On Highway Roadside Safety Prabhat Chauraha to Bajrang Chauraha Raisen Road Bhopal

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Abstract
This study evaluates highway roadside safety along Prabhat Chouraha to Bajrang Chouraha Raisen Road in Bhopal. Methods included a literature review, field observations, data collection, and analysis. A survey examined pedestrian and driver behaviors concerning safety. Results showed that pedestrians often ignore safety measures, while drivers frequently violate speed limits and engage in reckless behaviors. Poor pedestrian facilities, inadequate lighting, and weak enforcement exacerbate these issues. Speed calculations indicate that vehicles should not exceed 19.11 mph (30.77 km/h) on curved sections for safety. The study emphasizes the need for better speed regulations and safety measures to enhance roadside safety and reduce accidents in Bhopal.

Keyword: Highway roadside safety, Raisen Road, Pedestrian behavior, Driver behavior, Speed limits.

INTRODUCTION

Raisen Road (NH146) is a significant arterial road in Bhopal, the capital city of the Indian state of Madhya Pradesh. It serves as a crucial transportation corridor connecting various parts of the city and facilitating movement to neighbouring areas. NH146 connects Bhopal, Raisen, Sanchi, Vidisha, Rahatgarh and terminates at Sagar in the state of Madhya Pradesh.

Raisen Road is known for its commercial establishments, residential areas, and educational institutions located along its route. It plays a crucial role in Bhopal's overall transportation network, contributing to the city's connectivity and economic activity.

Details of Raisen Road highway

Raisen Road, a vital artery in Bhopal, serves as a crucial link connecting various neighborhoods and facilitating transportation within the city. Over the years, it has undergone significant developments to accommodate the growing traffic demands. Supervised and completed by the N.H. Division Bhopal, the road stretches from 'Bajrang Chauraha' to 'Prabhat Chauraha' and serves as an extension of National Highway No. 86, now designated as New N.H. 146.

Traffic Intensity

The traffic intensity on Raisen Road is substantial, with a Passenger Car Unit (PCU) count reaching a staggering 17,439 per day. To manage this influx, the road is designed as a two-way four-lane bitumen road. The carriage way boasts a width of 15.20 meters, providing ample space for vehicles traversing in both directions. The total formation width extends to 19.20 meters, ensuring sufficient room for smooth traffic flow.

Road Safety Issues of "Prabhat Chauraha to Bajrang Chauraha" Raisen Road Highway, Bhopal

Road safety issues on Raisen Road Highway in Bhopal are multifaceted and require careful consideration to mitigate risks and ensure the safety of road users. Some key concerns include:

Traffic Congestion (As per "IRC:108-2015"): Experiences heavy traffic congestion, especially during peak hours in morning time 9:00 am to 11:00 am and evening time 5:00 pm to 7:00 pm leading to delays and frustration among commuters. The high volume of vehicles, coupled with inadequate road infrastructure, exacerbates congestion issues and increases the likelihood of accidents.

Figure 1 Photo of Raisen Road Highway (Near Anand Nagar, Bhopal)

This photograph shows the critical concern about the traffic congestion in raisen road Bhopal. This is also inconvenience to the road user.

Lack of Pedestrian Facilities (As per "IRC:103-2012"): The road lacks proper pedestrian facilities such as footpaths, crosswalks, and pedestrian signals, posing significant risks to pedestrians. Without designated areas for pedestrians to walk safely, they are forced to navigate through traffic, increasing their vulnerability to accidents.

Figure 2 Photo of Raisen Road Highway (Near Old Subhash Nagar, Govindpura, Bhopal)

The Photograph captures a critical concern as lack of visibility in zebra crossing.

Inadequate Lighting {As per "IS:1944 (Part:- 5) - 1981 "}: Insufficient street lighting along certain stretches of Raisen Road compromises visibility, particularly during nighttime hours. Poor lighting conditions make it challenging for drivers to spot pedestrians, cyclists, and other vehicles, heightening the risk of collisions.

Unsafe Intersection (As per "IRC:SP:041"): Some intersections along Raisen Road have poorly designed layouts or lack proper signage and signals, leading to confusion and unsafe maneuvers by drivers. Inadequate intersection design increases the likelihood of rear-end collisions, side-swipes, and other accidents.

Figure 3 Photo of Raisen Road Highway (Near JK Road, CPRI Colony, Bhopal)

This picture shows the unavailability of road signs just before the intersection and uneven surface.

Over-Speeding and Reckless Driving (As per "IRC:SP:044"): Over-speeding and reckless driving behaviors are prevalent on Raisen Road, contributing to a significant number of accidents. The lack of strict enforcement measures and awareness campaigns further exacerbates this issue, endangering the lives of road users.

Poor Road Maintenance (As per "IRC:82-2015"): Sections of Raisen Road may suffer from potholes, uneven surfaces, and other road defects due to inadequate maintenance. These conditions not only cause discomfort to drivers but also increase the risk of accidents, especially for two-wheeler riders.

Figure 4 Photo of Raisen Road Highway (Near Punjabi Bagh Colony, Bhopal)

In this photograph show the uneven surface, this causes the vehicle damage and increases the travel time.

Figure 5 Photo of Raisen Road Highway (Indrapuri C-Sector, Bhopal)

This photograph captured a critical concern about the pot hole holds the water damage in raisen road highway.

Encroachments and Illegal Parking (As per "IRC:SP:12-2015"): Illegal encroachments onto the road space and unauthorized parking along Raisen Road obstruct traffic flow and visibility, creating hazardous conditions for motorists and pedestrians alike.

Addressing these road safety issues on Raisen Road Highway in Bhopal requires a comprehensive approach involving infrastructure improvements, stricter enforcement of traffic regulations, public awareness campaigns, and community engagement. By addressing these concerns systematically, authorities can enhance road safety, reduce accidents, and improve the overall commuting experience for residents and visitors alike.

Figure 6 Photo of Raisen Road Highway (Near CPRI Colony, Bhopal)

This photograph shows illegal parking in this road and it is inconvenience to the road user.

LITERATURE REVIEWS

(Manjunatha & Chetty, 2019) **"Road traffic accidents in India- A theoretical framework"** There is a tremor in the Indian road accident scenario. According to data collected in 2014, vehicle accidents claim the lives of one person every 3.75 minutes. The country's wealth has taken a major hit due to the high accident rate, which is mostly attributable to the inadequate state of the country's highways and other major roads. Those without motorized vehicles, such as pedestrians, bikers, and motorcyclists, are often the ones who suffer the most. Pedestrians had a greater risk of

death, more severe injuries, and more injuries overall compared to victims in vehicles.

(Bharat Kumar & Jeswanth Chowdary, 2018) **"Road safety audit: a case study on NH-65"** The majority of freight traffic (about 65%) and passenger traffic (about 80%) in India occurs on the country's 33 lakh kilometers of roads. over 1.7 percent of all roads are national highways, although national highways handle over 40 percent of all traffic. Over the last five years, the number of automobiles has been steadily rising, with an annual growth rate of 10.16 percent. The purpose of a road safety audit is to formally determine the likelihood of accidents and the degree to which current road infrastructure can be improved and maintained via the planning and execution of new road projects. As far as road safety is concerned, the two primary approaches are accident prevention and accident reduction. The National Highway 65 (NH-65) between 270 and 247 kilometers in length is the primary route between VIJAYAWADA and HYDERABAD in this case study. Several settlements and industry, as well as heavy traffic, make the route a potential flashpoint at any given time.

(Detho et al., 2018) **"Evaluation of Road Traffic Accidents (RTAs) on Hyderabad Karachi M-9 Motorway Section"** The improvement of Pakistan's transportation infrastructure is crucial to the country's progress as a growing nation. This article details the results of a study that aimed to assess RTAs on the portion of the Hyderabad–Karachi M-9 Motorway. The goals of the survey are to gather information on traffic accidents, including the number of casualties and property damage, and to assess the factors that contribute to RTAs. It was found that 145 RTAs happened on the highway between 2015 and 2016. There were 109 fatalities, 293 injuries, and 251 damaged cars in the RTAs. People using foot and automobile traffic were also found to be at high risk.

(SINGH et al., 2013) **"Quantification of Level-of-Service Index for Bus Routes in Developing Countries: A Case Study in India"** Any public transportation system's viability is directly related to the level of service it provides, which is of paramount importance in a market-oriented economy. In most Indian cities, the demand for transportation is often higher than the supply, hence service providers frequently neglect to prioritize the quality of service. But in order to raise the bar on service quality, we need to find out what factors commuters value most in order to gauge their level of satisfaction with the current system. The findings from the revealed preference (RP) survey, which was used to assess the service quality, are the main topic of this article. Numerous multi-criteria decision-making approaches, including the Analytic Hierarchy Process (AHP), AHP Fuzzy, a numerical rating approach, and a fuzzy set approach, are included into the model. We compare and justify the outcomes of various techniques based on their appropriateness.

RESEARCH METHODOLOGY

The study is based on a survey methodology. The respondents are selected randomly from users of the Raisen road, Bhopal. A questionnaire was prepared for the respondents and 80 responses were collected. These responses were analyzed and interpreted with the help of IBM SPSS. Along with the survey, an experimental analysis was also made to determine the speed limit for the road. Prabhat chauraha to Bajrang chauraha Raisen Road in Bhopal has been strategically selected as the area for this study due to several critical factors that make it an ideal candidate for examining highway roadside safety.

DATA ANALYSIS AND INTERPRETATION

Table 1 Age group

Age group					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 years to 25 years	30	37.5	37.5	37.5
	26 years to 35 years	26	32.5	32.5	70.0
	36 years to 45 years	15	18.8	18.8	88.8
	46 years and above	9	11.3	11.3	100.0
	Total	80	100.0	100.0	

"Based on the age group, this survey comprised of 30 respondents within the age group of 18-25 years, 26 respondents within the age group of 26-35 Years, 15 respondents within the age group of 36-45 years and 9 respondent within the age group of 46 and above".

Table 2 Gender

Gender					
		Frequency	**Percent**	**Valid Percent**	**Cumulative Percent**
Valid	Male	57	71.3	71.3	71.3
	Female	23	28.7	28.7	100.0
	Total	80	100.0	100.0	

As exhibited in the above-mentioned table, there are 57male and 23 females in the study.

Table 3: Views of the respondents

	Strongly agree	**Agree**	**Neutral**	**Disagree**	**Strongly Disagree**
Unmarked road signs at Raisen road highway, Bhopal are the prime reasons for the occurrence of accidents	44	13	1	8	14
The visibility of the road is low that causes more accidents	37	10	12	1	20
The frequency of rest areas and service stations on highways is inadequate for driver convenience and safety	43	7	17	10	3
There is unavailability of emergency call boxes or roadside assistance services in case of breakdowns or emergencies	20	28	15	13	4
The overall maintenance and upkeep of the highway infrastructure can contribute to overall roadside safety.	38	24	15	3	0
Pedestrians avoid using the designated crosswalks when crossing the highway roadside	17	13	21	24	5
Pedestrians are very negligent about crossing the highway roadside	31	18	18	5	8
Pedestrians are always seen using smartphones or listening to headphones while crossing the highway roadside	59	11	5	5	0
Pedestrians avoid following the traffic signals and direction while walking at highway roadside	36	24	12	1	7
Pedestrians do not account for the speed of vehicles when crossing the road	31	31	6	3	9
Drivers avoid the prescribed speed limit without considering the consequences	23	24	15	0	18
Drivers become usually careless while driving at highways in comparison to when they drive within the city roads	31	16	23	8	2
Drivers ignore crosswalk signs and even the pedestrians' safety, especially at highways	36	30	13	0	1
The level of driver education and awareness about highway roadside safety is satisfactory	36	31	8	4	1
The speed limits on highways are appropriate for ensuring safe driving conditions	33	19	8	12	8

ASSUMPTIONS TESTING

Assumption 1

A_{01}: There is no significant impact of pedestrians' behaviour on highway roadside safety at Raisen Road, Bhopal

A_{a1}: There is a significant impact of pedestrians' behaviour on highway roadside safety at Raisen Road, Bhopal

Figure 7 Assumption 1

ANOVA					
Highway roadside safety					
	"Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	383.821	9	42.647	49.617	.000
Within Groups	60.167	70	.860		
Total	443.988	79"			

Interpretation: From the above table, it is interpreted that there is a significant impact of pedestrians' behaviour on highway roadside safety at Raisen Road, Bhopal; since, sig.<0.05.

Assumption 2

A_{02}: There is no significant impact of drivers' behaviour on highway roadside safety at Raisen Road, Bhopal

A_{a2}: There is a significant impact of drivers' behaviour on highway roadside safety at Raisen Road, Bhopal

Figure 8 Assumption 2

ANOVA					
Highway roadside safety					
	"Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	386.028	9	42.892	51.803	.000
Within Groups	57.959	70	.828		
Total	443.987	79"			

Interpretation: From the above table, it is interpreted that there is a significant impact of drivers' behaviour on highway roadside safety at Raisen road, Bhopal; since, sig.<0.05.

Experimental Result

The study aimed to find the maximum speed possible at a horizontal curve of Raisen road highway.

The safe speed for a horizontal curve can be calculated using the formula:

$V = \sqrt{(R \times f \times g)}$

Where:

- V is the safe speed (in miles per hour or kilometers per hour, depending on the units used).
- R is the radius of the horizontal curve (in feet or meters).
- f is the coefficient of friction between the vehicle's tires and the road surface (unitless).
- g is the acceleration due to gravity (32.17 ft/s^2 or 9.81 m/s^2).

Putting the measured values to the formula:

$V = \sqrt{(R \times f \times g)}$

$V= \sqrt{(16.24*0.7*32.17)}$

V= 19.11 miles per hour; or, 30.77 kms per hour

The analysis of the Raisen Road Highway in Bhopal determined that the safe speed for vehicles navigating a horizontal curve can be calculated using the formula $V= \sqrt{(R \times f \times g)}$, where V represents the safe speed. By applying the measured values to the formula, considering the radius of the horizontal curve (16.24 feet), the coefficient of friction between the vehicle's tires and the road surface (0.7), and the acceleration due to gravity (32.17 ft/s^2), it was determined that the safe speed for vehicles on this curve should not exceed 19.11 miles per hour or 30.77 kilometers per hour. This finding highlights the importance of adhering to recommended speed limits on curved sections of the Raisen Road Highway to ensure safe maneuvering and reduce the risk of accidents. Implementing and enforcing appropriate speed regulations based on such calculations is crucial for enhancing road safety and mitigating potential hazards for motorists traveling along the highway.

CONCLUSION

Based on the analysis of pedestrian and driver behavior at Raisen highway in Bhopal it is evident that there are several key factors affecting the roadside safety. These factors include:

1. Many pedestrians do not adhere to basic safety precautions such as using designated crosswalks staying on sidewalks or paying attention to oncoming traffic. This puts them at higher risk of accidents or collisions with vehicles.

2. Drivers often fail to adhere to speed limits and exhibit reckless behavior such as overtaking in prohibited areas or driving under the influence of alcohol or drugs. This not only endangers their own lives but also puts pedestrians at significant risk.

3. The absence of proper pedestrian facilities such as well-maintained sidewalks dedicated pedestrian crossings and sufficient street lighting contributes to the unsafe conditions for both pedestrians and drivers.

4. There is a lack of strict enforcement of traffic rules and regulations. This results in drivers not facing

penalties for violations which further encourages negligent behavior and puts pedestrians at higher risk.

Based on the analysis conducted by applying measured values to the formula, including the radius of the horizontal curve, coefficient of friction, and acceleration due to gravity, it was determined that the safe speed for vehicles navigating the curve on Raisen Road Highway should not exceed 19.11 miles per hour or 30.77 kilometers per hour. This finding underscores the critical importance of adhering to recommended speed limits on curved sections of the highway to ensure safe maneuvering and reduce the risk of accidents. Implementing and enforcing appropriate speed regulations based on such calculations is essential for enhancing road safety and mitigating potential hazards for motorists traveling along the highway. This conclusion highlights the significance of evidence-based decision-making in promoting safer road environments and underscores the need for proactive measures to protect the lives and well-being of all road users.

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