Identification and Analysis of Blackspot on Agra-Lucknow, Expressway, Uttar Pradesh, India

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Abstract - India is a developing nation and wellbeing of road is still in an untimely stage. Accident seriousness is increasing with increase in Vehicle Population. Road users in India are heterogeneous in nature, ranging from pedestrians, animal- driven carts, bi-cycles, rickshaws, hand carts and tractor trolleys, to various categories of two/three wheelers, motor cars, buses, trucks, and multi-axle commercial vehicles etc. Records show that there is one death at each 2.75 minutes in view of road accidents. The high accident rate is to a great extent credited to the insufficiency of the expressways and other major roads to satisfy the traffic demands, vehicle defects, poor road geometrics road user behavior, and visibility. The no. of accidents is rising up every year due to increasing vehicles population.

The location in a roadway where the traffic accident often occurs is called a black spot. The accident data is analyzed using accident frequency and severity index method. The safety deficiencies were detected to minimize accidents and save the road users. Taking the Agra-Lucknow Expressway as the source project, accidental study will be carried out. The deficiencies along with the measures for further improvement have been presented in this thesis.

An experimental field investigation was carried out on Agra-Lucknow Expressway in this paper. Here we have focused on to identify the blackspots on Expressway and to provide sustainable solutions to those blackspot sections.

Keywords—Accidents; Safety; Blak spot; Expressway

1. INTRODUCTION

Road Transport is the primary method of transport which plays a significant role in transportation of goods and passengers and provide connections to production units, utilization and distribution. It is additionally a key factor for advancing financial improvement regarding social, local and national integrity. The road transportation increases year by year, yet the pace of road crashes also increases with it. India is one of the developing nations, where the rate of road crashes is more than threshold limit. Road accidents are a human misfortune, which include high human suffering. They force a huge socio-economic loss in terms of untimely deaths, injuries and loss of income. The consequence of road accidents can be epic and its negative effect is felt on people, their wellbeing and government assistance, yet additionally on the economy. Consequently, road safety has become an issue of public and national concern.

Road accidents not only impose huge economic losses representing between 1-3 % of annual Gross Domestic Product in most countries but also causes great emotional and financial loss to the millions of families affected. India is the developing country, and the Highways are the most vulnerable places for the occurrence of the accidents. In other words, it allows engineering aspects of both, roads and vehicles on one hand and the provision of health and hospital services for trauma cases in post-crash scenario.

A. PROBLEM STATEMENT

In 2016, there were 35,612 road crashes in Uttar Pradesh, which resulted in 19,320 deaths and left 25,096 persons injured. Yet again, Uttar Pradesh emerged as the state with the highest road crash deaths in India and 12.8% of the total persons killed in road crashes in India were in Uttar Pradesh alone. Uttar Pradesh was the state with the highest fatal road crashes in 2016 (16,164) as well as 2015 (15,218). Grievous injury crashes were second highest in the state of Uttar Pradesh (14,471) in India. Uttar Pradesh was also the state in India with the highest number of underage drivers killed in road crashes in 2016 (1,062). The percentage share of Uttar Pradesh in total road crashes is high at 7.4% and in total road crash fatalities is 12.8%.

B. SCOPE OF WORK

The study area selected is Agra- Lucknow Expressway. To carry out the data colleciton from UPEIDA. To carry out field investigation for indentifcation and analysis of Blackspot present on Agra- Lucknow Expressway.

C. OBJECTIVES OF STUDY

The major objectives of the present work are listed below:

(i) To study the daily variation in accident rate on selected Stretches of Agra-Lucknow Expressway.

(ii) To identify the blackspot on Agra- Lucknow Expressway on the basis of data analysed.

(iii) To propose preventive measures in order to minimize the rate of accident.

2. ROAD ACCIDENT SITUATION IN UTTAR PRADESH, INDIA

Out of the total of 35,612 cases of road crashes in 2016, 24,793 occurred on National and State Highways which resulted in 13,679 fatalities out of a total of 19,320 fatalities in Uttar Pradesh. It is the state with the highest number of road crash deaths on both National and State Highways in India:

Table -1:	Cases	Injured	Fatalities
National Highways	13,078	9,197	7,469
State Highways	11,715	8,003	6,210
Total	24,793	17,200	13,629

In 2016, Uttar Pradesh was the state with the highest number of road crash deaths caused by Motor Cycle/Scooter, Taxis, Truck/Lorry and Motor cars in India.Road crash deaths in Uttar Pradesh based on vehicles primarily responsible:

Table -2:	Road Crahes	Fatalities
Motor Cycle/ Scooter	10052	5328
Moped-Scooty	1523	756
Auto Rickshaw	1871	877
Bus	2853	1652
Motor Car	4175	2299
Jeep	2140	1102
Taxi	2238	1168
Truck/Lorry	4731	2795
Tempo	1879	1090

Uttar Pradesh was the state with the highest number of road crashes, persons injured and killed due to both, mobile phone usage and intake of alcohol in India. Distribution of road crashes in Uttar Pradesh based on responsibility of the driver:

Table -3: Cause of Road Crash	Crashs	Injured	Fatalities
Exceeding lawful speed	10184	5976	5471
Intake of Alcohol	4633	2905	2716
Asleep/Fatigued/ Sick	1121	964	603
Using Mobile phones while driving	1595	1257	874
Overtaking	3937	2914	1926

3. LITERATURE REVIEW

Many factors may exhibit a measurable influence on driving behaviour and traffic safety on two-lane highways. These include:

(i) Human factors such as improper judgment of road ahead and traffic, driving under the influence of alcohol or drugs, driver education and experience, young driver, age and sex.

(ii) Traffic factors like speed, volume, density, capacity, traffic mix and variation.

(iii) Vehicle deficiencies, such as defective brake, headlight, tyres, steering and vehicle condition.

(iv) Road condition like slippery or skidding road surface, ravels, pot hole, ruts etc.

(v) Road design such as inadequate sight distances, shoulder width, no of lanes , improper curve design, improper lighting and traffic control devices.

(vi) Weather condition like fog, heavy rainfall, dust, snow etc.

(vii) Other causes such as enforcement, incorrect sign and signals, service station, badly located advertisement, stray animals etc.

Chandraratna et al. (2006)[1] studied licensed driver involvement in a crash. Using logistic regression, it was found very young and old male drivers are responsible due to both speeding and non-speeding.

Deery (1999) [2] studied about hazard and risk perception among young novice driver and concluded that hazard and risk perception are fundamental skill that young drivers need to develop.

Shivkumar and Krishnaraj (2012) [3] studied that alcohol causes deterioration of driving skills even at low levels and the probability of accident increases with rising blood alcohol levels. Alcohol needs no digestion and is absorbed rapidly into the blood stream; about 10% to 15% of alcohol users develop alcohol dependence and become alcoholics. After drinking, the judgment power of the driver gets impaired which is a threat to road safety. Due to its effects, driver tends to take more risks, becomes more aggressive and takes a longer reaction time. The relative probability of causing accidents increases with the rising blood alcohol levels keeping road safety at stake.

Labat et al.,(2003) [4] conducted a new study during 2003-2004.They found urine ethanol as positive in 50 cases,

cannabinoids in 85 cases, opiates in 41 cases, amphetamines in 3 cases, cocaine in 1 case, buprenorphine in18 cases, methadone in 5 cases and benzodiazepines in 4 cases. Drugs in particular ethanol and cannabinoids are responsible for fatally injured drivers.

Lee at al.,(2006) [5] developed a real- time crash prediction model by taking total travel time and Crash potential reduction. The study result indicated the variable speed limit could reduce crash potential by 5-17%.

Prabhakharn et al.,(2011) [6] analyzed that imparting training among drivers reduces speeding behavior. They used speed as dependent variable and distance as function in ANOVA.

Houquani et al.,(2012) [7] investigated hospitalized drivers who were involved in road traffic collision between April 2006 to October 2007 in UAE.A logistic model was fitted using the variables like drivers demographic data, time, date, location, mechanism of collision, speed at collision and sleepiness. The conclusion was sleep is an important factor to road traffic collision.

Sreedharan et al.,(2010) [8] explored the determinants use of crash helmets among motorcyclist in India. A cross sectional study conducted in Kerala .The study found only 73.1% of motorcyclist were not using helmet which results more head injuries during crash in that region.

Osama et al.,(2012) [9] studied that One overloaded axle causes damage equivalent to 22 legally loaded axles. Overloaded vehicle increases maintenance cost and hazard.

Mohmed et al., (2011) [10] studied on crash related to visibility obstruction due to fog and smoke in Florida. It was found that fog smoke related crashes are more likely to occur at night without street lighting leading to more severe injuries. Head-on and Rear-end are common crashes in terms of crash risk and severity. These crashes are more prevalent on high speed road, undivided roads, roads with no sidewalks and two lane rural roads.

Zhuanglin(2009) [11] fitted a multiple logistic relationship between accident severity and a series of potential factors like- Cross section, pavement type, accident location, traffic environment, traffic environment, lighting. He found that major accident was on expressway as compared to arterial street.

4. STUDY AREA

Agra- Lucknow Expressway is 302 km in length and is 6-lane expressway with service lanes on both the sides. This expressway connects Agra, Firozabad, Mainpuri, Etawah, Auraiyya, Kannauj, Hardoi, Kanpur city, Unnao and Lucknow. It is constructed using EPC (Engineering, Procurement and Construction) methodology. This expressway is equipped with all possible modern amenities like Advance Traffic Management System (ATMS) and modern digital control rooms. Expressway is provided with way-side amenities at 101 km (LHS), 217 km (RHS), 104 km (RHS) and 227 km(RHS) like food plazas with parking space, modern toilets, rest houses, petrol pumps and automobile workshops.

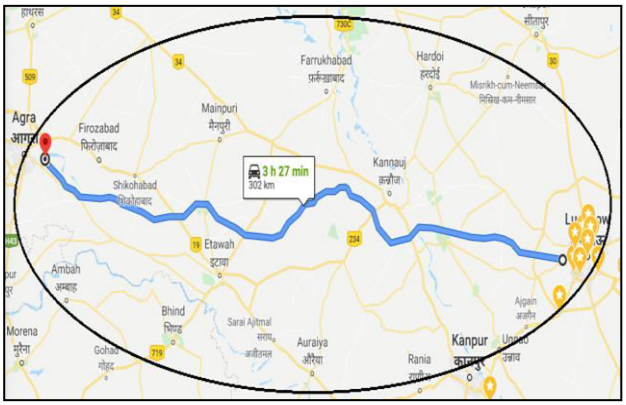

Fig -1: Study area, Source: Google Map

Expressway has various medical facilities available at suitable distances 24x7 like CHC Fatehabad, Medical College Agra, PGI Safai and various others. 10 Mobile ambulances with life support systems are available 24x7 at 21, 53, 76, 117, 154, 172, 192, 220, 269, 200, 290 km benchmarks.

Expressway is patrolled by 15 UPIEDA, 20 EAGLE patrolling vehicles. These patrolling vehicles have 200 security personnels who patrols the expressway as per their shifts. Other than this 3 retired deputy superintendent of police (DSP), 5 retired Inspectors, and 5 retired Sub-Inspectors are also deputed for security purpose. Except security provided by UPIEDA, up state has provided 27 vehicles of DIAL-112 service for emergency response.

5. METHODOLOGY

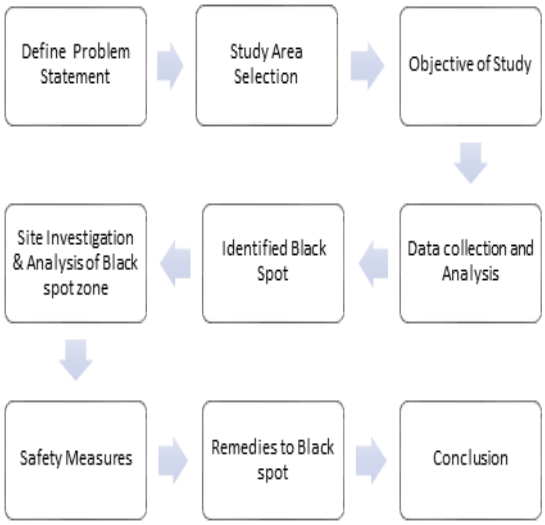

Fig -2: Methodology Steps

Methodology starts with defining problem statement, it details out the subject of work. Then literature review helped to understand subject as the subject data collected in previous years has been studied. The third step was to select study area suitable for the objective. Data collection and analysis was carried out. Once the data is analyzed, on the basis of analysis results some remedial measures for road safety were suggested

to UPEIDA. Last step was to give conclusion to the work completed.

6. DATA COLLECTION

The only information available for accident studies is the accidents list that are made by Uttar Pradesh Industrial Expressway Development Authority (UPIEDA). This data was made with the help expressway patrolling staff and FIR (First Information Report) lodged in the police stations. The data from these records of last three years (2018-2020) were extracted from the UPIEDA accident record. Vehicles those involved in accidents and reported in the F.I.R. The categories of vehicles include car, tempo, mini-truck, minibus, tractor, motor cycle, tanker, trailor (articulated vehicle), truck and bus.

With the prior permission of the concerned UPIEDA personnel's, the accident data were collected on six-lane expressways from UPIEDA site office.

The Site office have their own accidental records of last 03 years (As the expressway has been fully operational from 2018). A sample copy of the proforma is shown in the Table no. 04.

Table -4: Proforma for accident data from FIR records

Date	Crash Time	Accident		Vehicle number	Vehicle(s) Involved	Injured	Serious	Deceased, Name & Address	Cause of Accident	Driver's name & Details	Possible Reasons
		Km.	LHS/RHS								

Accident data were collected and sorted out month and year wise. The data represented here only contains details of grevious as well as casualities data.

7. DATA ANALYSIS

From the data acquired by UPIEDA office, data was later on collected and redistributed according to the definition of Blackspot given by MORTH, **Road Accident Blackspot is a stretch of National Highway of about 500 m in length in which either 5 road accidents (in all three years put together involving fatalities/grievous injuries) took place during the last 3 calendar years or 10 fatalities (in all three years put together) took place during the last 3 calendar years.**

Following the definition, the whole 302 km section of Agra-Lucknow Expressway is divided into 500 m span length section and the total road length was divided into 604 test sections respectively. Accidental data of all the 3 years available was then analysed on MS-Excel software and the total count of the accidents/grievous injuries or fatalities were calculated.

A Proforma for the calculation of all 604 test sections for the data of whole year is as below in Table no.06.

Table -5:

Yr. 20XX			Month 01		Month 02		No. of Grievous Injuries	No. of Fatalities	No. of Accidents.
S.No.	LHS (Km)	RHS (Km)	Serious	Dead	Serious	Dead			
1	0	302	xx	xx	xx	xx	0	0	0
2	0.5	301.5	xx	xx	xx	xx	0	0	0
3	1	301	xx	xx	xx	xx	0	0	0

A. *IDENTIFICATION OF BLACKSPOT*

A total of 6 Blackspots were identified along the total stretch of 302 km according to the definition of Blackspots of MORTH. These 6 (Six) point are as shown in Table given below:

Table -6: Blackspot Counts and Reasons of being a Black Spot on Agra- Lucknow Expressway

S.No.	LHS (km)	RHS (km)	Reason for Being Blackspot (No. of Accident>10/ No. of Fatalities>5)
1	56	246	Accident
2	71.5	230.5	Fatalities
3	108	194	Accident
4	179	123	Fatalities
5	279.5	22.5	Accident
6	302	0	Accident

B. *BLACK SPOT INVESTIGATION*

The point where accident occurs frequently is known as black spot or accident point. Analysis is required for improving traffic environment. The details of six stretches are shown in Table 5.1. According to the data collected and analysed, there were 6 identified blackspots on Agra-Lucknow Expressway.

A field investigation was set out along with the help of UPIEDA site staff. Each blackspot section was studied for its geographical and road adjacent features. Google map location coordinates and photos of the particular section and documented.

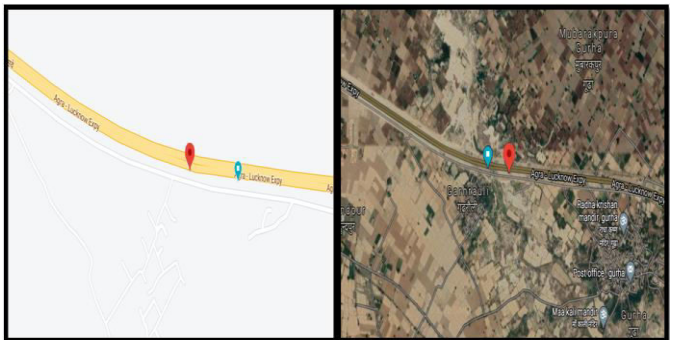

Fig -3: Map Point Location for Section 56 LHS / 246 RHS

Fig -4: Accidental site Point Location for Section 71.5 LHS / 230.5 RHS

8. PREVENTIVE MEASURES FOR ACCIDENTS

i. DEFENSIVE DRIVING

Everyone on the road has the right of way, and common sense is in practising it whenever you find a vehicle in a hurry. This fundamental habit or quality is Defensive Driving. It is safe and a smart way to prevent road accidents. By being obstinate, blocking the path, or impeding the passage of a vehicle, you might end up increasing the risk of an accident.

ii. DISTANCE BETWEEN THE VEHICLES

Avoid being a tailgater by driving too close to the vehicle in front of you. Driving too close deprives you of the adequate space needed to decelerate during a sudden stop, especially if the vehicle ahead hit brakes abruptly. If you are a driver of a truck or trailer, then take more precaution in maintaining the distance because it takes almost 40% longer for a trailer to stop as compared to a car.

iii. AVOIDING OVER SPEEDING OF VEHICLE

At high speed the vehicle needs greater distance to stop i.e. braking distance. A slower vehicle comes to halt immediately while faster one takes long way to stop and also skids a long distance due to law of notion. A vehicle moving on high speed will have greater impact during the crash and hence will cause more injuries. The ability to judge the forthcoming events also gets reduced while driving at faster speed which causes error in judgment and finally a crash.

iv. DRUKEN DRIVING

For every increase of 0.05 blood alcohol concentration, the risk of accident doubles. Apart from alcohol many drugs, medicines also affect the skills and concentration necessary for driving. First of all, we recommend not to consume alcohol. But if you feel your merrymaking is not complete without booze, do not drive under the influence of alcohol. Ask a teetotaler friend to drop you home.

v. AVOIDING DISTRACTION TO DRIVER

Some of the distractions on road are:

1.Adjusting mirrors while driving
2.Stereo/Radio in vehicle
3.Animals on the road
4.Banners and billboards.

The driver should not be distracted due to these things and reduce speed to remain safe during diversions and other kind of outside distractions.

Distracted driving resulted in a slow reaction to critical or potentially dangerous conditions. So, don't listen to loud music, eat food, smoke, apply makeup, text on a mobile phone or do anything else that distracts you while driving. Distracted driving leads to severe road accidents. It delays your reaction causing 90% of rear-end accidents.

vi. USE OF SAFETY GEARS LIKE SEAT BELTS AND HELMETS

Use of seat belt in four-wheeler is now mandatory and not wearing seat belt invites penalty, same in the case of helmets for two wheeler drivers. Wearing seat belts and helmet has been brought under law after proven studies that these two things reduce the severity of injury during accidents. Wearing seat belts and helmets doubles the chances of survival in a serious accident. Safety Gears keep you intact and safe in case of accidents. Two wheeler deaths have been drastically reduced after use of helmet has been made mandatory. One should use safety gears of prescribed standard and tie them properly for optimum safety.

9. CONCLUSION

i. The available literatures on accident analysis indicate that 77.5 percent of road accidents in India are caused due to driver's error.

ii. Trucks, buses and cars are involved in maximum no of accident on Expressway. It is estimated that fatalities caused by truck is 59 % followed by cars (26%) and bike (7%) and others (5%) and bus (3%). Road safety awareness should be raised among road user.

iii. Stretch II has the highest no of fatalities amongst all the blackspot section, while Stretch III has highest no. of accidents amongst the blackspots section. The accident rate can be decreased by road side clearance, proper maintenance of shoulders, lighting, and junction improvement. Speed limit should be brought down by providing humps near accident spots. Sight distance near curves should be obstruction free.

iv. The Accident rate can be reduced by providing signalized junction, junction improvement, and shoulder Clearance, installation of humps, shifting of poles near the edge of pavement etc.

v. Traffic awareness is the key role player in Indian traffic conditions.

10. RECCOMENDATION

i. Amber Light alert system at the merging of the traffic on Expressway.

ii. Speed Restriction over the Blackspot zones, in order to eliminate the effects of Blackspot.

iii. A LED display board can be installed at every Toll entry point; this display board will flash the recent accidents along with the reason of accident. This will increase the attentiveness of drivers on expressway and also discourage the over speeding of vehicle.

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