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Effects of Roadway Condition and Traffic Features on Road Safety

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Abstract - *India is a developing country and safety of road is still in a premature stage. Accident severity is growing in increasing order due to day by day growth in vehicle population. Accident leads to disablement, death, damage to health and property, social suffering and general degradation of environment. The road accident situation in India is alarming. The high accident rate is largely attributed to the inadequacy of the highways and other main roads to meet the traffic demands, road user behavior, vehicle defects, poor road geometrics and visibility. Road accidents inflict heavy economic loss to the country. Road Safety is necessary to reduce accident involving both human and vehicles, henceforth constructing the road as user friendly and safe is priority. The number of accidents is rising up every year due to increasing vehicles population. The location in a National Highway/ State Highway and other roads where the traffic accident often occurs is called a black spot. The accident data is analyzed by MoRTH protocol to identify blackspots on selected stretch. The safety deficiencies were detected to minimize accidents and save the road users. The deficiencies along with the measures for further improvement have been presented in this thesis. The study aims to find out the safety problems for project stretch and providing remedial and mitigating measures to reduce the road accident on project road.*

Key Words: Accident, National Highway, MoRTH, blackspots, mitigating measures, minimize.

1. INTRODUCTION

In 2018, National and State Highways comprises of total road network of 1.94 % and 2.97% and 95.1% comprises with other roads like VR, MDR, ODR, etc. total road accidents comprise in NH is 30.2%, State highway is 25.2% and balance comprises with Other road to 45%, in which fatal accidents results to 35.7 % in NH, 26.8 % in SH and 38% in other roads.

The number of road accidents pertaining to pedestrian, cyclists and two wheeler is resulted as 15%, 2.4% and 36.5%. All together this implies 53.9% of road accident which is quite higher percentage in global trend.

Youth of an age group from 18-45yrs accounted to approximately 69.6% of road mishaps, the employed persons who aged from 18 to 60 comprises a portion of 84.7% in fatal cases.

In 2018, the death accident percentage for female was 14% and for male is 86%.

1.1 Statistics of India on the basis of accidents

- Under the classification of Traffic Rule Violations, over speeding is a foremost executioner, accounting to 64.4% of the individuals killed followed by driving the vehicle in wrong direction, which results 5.8% of fatal injuries. Drunken driving cases resulting to 2.8% fatal crashes and use of cell phones accounted to 2.4% of fatal crashes.
- 13% of accidents are caused by the people without the license as well as who are not proficient driver.
- In case of two wheeler 29% of fatal accidents recorded of not using helmets and in case of four wheeler 16 % of fatal accidents are recorded for not wearing seat belts.
- 41% of road accidents are held and resulted to death, whose fitness of the vehicle are not appropriate.
- Overloaded vehicles accounted for about 12% deaths.

As per the road accident in India, manual published in 2018 by Ministry of Road Transport and Highway, accidents occurred or taken place from year 2011 to 2018 on National highways, State Highways and Other roads.

Table -1: Summary of accidents and death from 2011-2018

Total Accident on Highways		**Total road death on Highways**	
Highways	**% age**	**Highways**	**% age**
Expressway/National Highway	30.16	Expressway / National Highway	35.69
State Highway	25.17	State Highway	26.80
Others Road	44.67	Others Road	37.50

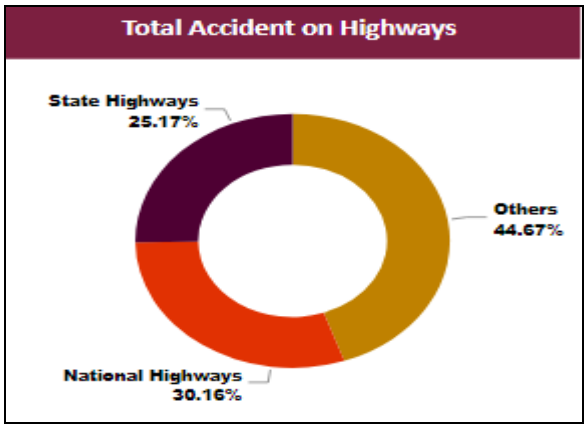

Fig -1: Total Accidents on Highways

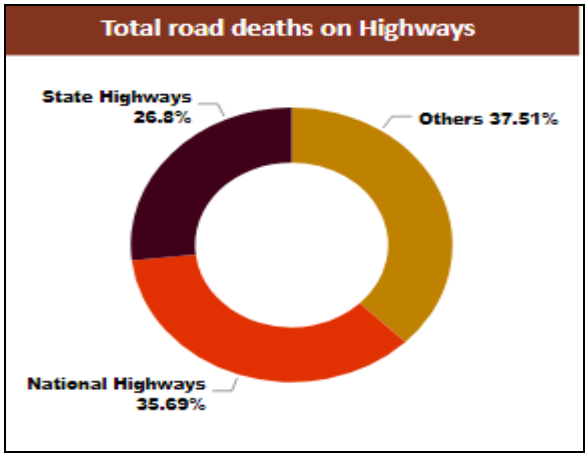

Fig -2: Total Road death on Highways

Table -2: Accidents resulted by road side features

Road Type	Nos. of Accidents	Percentages
Straight Road	605205	65%
Curved Road	118180	13%
Steep Grade	15430	2%
Pot Holes	14295	2%
Bridge	31640	3%
Culvert	20785	2%
Construction Zone	23360	3%
Others	103070	11%

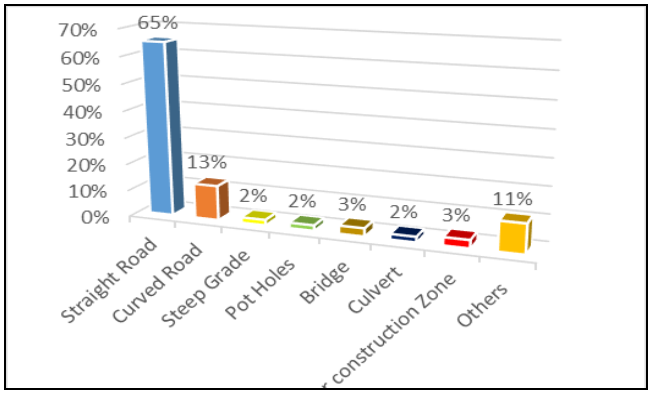

Fig -3: Accident recorded by Road features.

2. LITERATURE REVIEW

Constantinou et al, (2011) shows that drivers aging less than 25 years, where majorly identified with traffic offense.

Bassat and Shinar (2011), they concluded that Roadway design features is one the most important factor that influence safety for road users. And also they concluded that shoulder width affect the speed and position of the vehicle which leads to decrease in accident rates.

Jinsun and Doohee (2003) set up a connection between mishap seriousness and side of the road features. The outcome shows that run-off-roadway mishap can be diminished by maintaining a strategic distance from cut side angles, diminishing the good ways from outside shoulder edge to monitor rail, diminishing the number of segregated tree along roadway segment and expanding the good ways from outside shoulder edge to luminaire posts. Run-off terrain way mishap is an unpredictable cooperation of street side factors, for example, nearness of guardrails, incidental fixed item, sign backings, tree gatherings and utility poles along the street way.

3. OBJECTIVE

- To study the hourly and daily difference in accident on selected road.
- To identify the Black-spots as per Ministry of Road Transport & Highways protocol and suggest its rectifications or measures, to make the project stretch accident free.
- To identify deficiencies in Geometric Designs.
- To identify the safety issues in highway design to meet the needs of all types of traffic and to diminish the conflict zones.

4. STUDY AREA AND DATA COLLECTION

Study Area: Two Laning Baran - Aklera Section of NH-90 (Now NH-752) from Ch. 0 + 000 to Ch. 91+600 of total Length 91.600 Km in the State of Rajasthan.

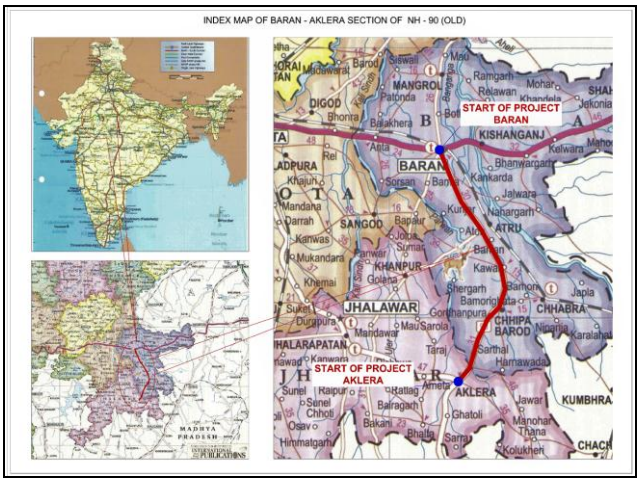

Fig -4: Index Map showing project stretch

5. RESEARCH METHODOLOGY AND ANALYSIS

a) Need of Crash Analysis

The primary source of crash data is the local enforcement agencies. Accident data are used to assist why mishaps is being occurred, to identify accident prone locations, to encourage in the safety programs or countermeasures, and to assist evaluations of countermeasure effectiveness. The main perseverance of accident analysis is to improve safety by identifying crash plans, mitigating, crash severity and minimizing the number of accident by executing suitable methods.

Fig -5: Accident Analysis flow chart

The first step is to determine the problem due to which accidents are occurring.

The second step looks at "why" the accident happened. It's being used to describe populations at high-risk for accidental injuries and to suggest specific mediations.

The third step is to assess what measures can be adopted to avoid the problem by using the information about causes and risk factors to design, pilot test and evaluate interventions.

The finishing step is the proposal of interventions that are very likely to be carried out on large scale.

b) Methodology

The key steps of the methodology are:

- Accident data collection for 3 year.
- Accident/ Crash Analysis.
- Identification of accidental black spots.
- Causes of accidents and proposal of recommendations.

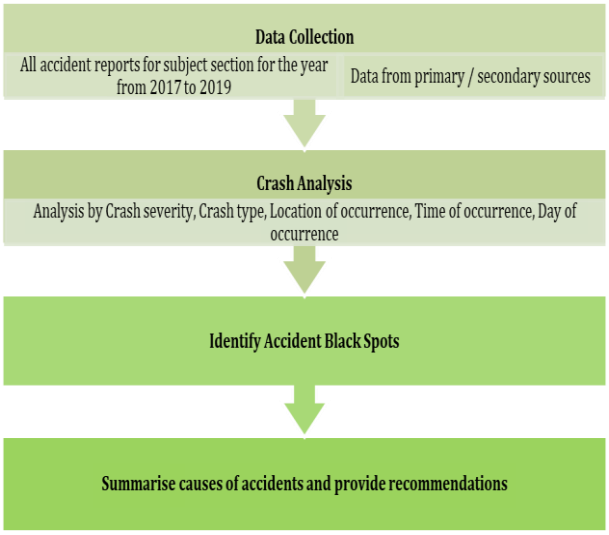

Fig -6: Flow chart for approach methodology

c) Crash Analysis

The main objective of crash analysis is to develop the safety of road users by identifying crash patterns, mitigating crash severity, analyzing the causes for accidents and to recommend suitable safety measures to eliminate accidents and to provide a safe, comfortable journey with reasonable travel time.

The procedure of crash analysis study is as follows:

a) Review of crash data considering of entire sections.
b) Identify locations with high crash occurrences
c) Quantify main crash trend(s) for the location(s)
d) Determine the causes of problems

There are two methods for determination of black spot /Accident Prone Locations:

1. **Based on Accident Severity Index**

ASI = (Nf x Wf) + (Ng x Wg) + (Nm x Wm)

The Threshold value can be evaluated by the formula described below

$$= \bar{v} + 1.5\sqrt{\left(\frac{\sum[V-\bar{v}]^2}{(N-1)}\right)}$$

Where V =V_1, V_2..... V_n are the ASI values of locations 1, 2.....n.

$\bar{v}$= Average ASI value= $\frac{V1+V1+\cdots\ldots+Vn}{N}$

Where N is the total number of ASI values.

2. Based on MoRTH Protocol

Road Accident Black spots is a stretch of National Highway of about 500m in the length in which either 5 road accidents (put together involving fatalities/grievous injuries) or 10 fatalities took place during the last 3 calendar years.

6. RESULTS AND FINDINGS

- *Nature of Accidents*

The accident data have been collected and analyzed below to identify the type of accidents, location, time, vehicle type, other contributing factors, and environmental factors associated with injury severity. It was observed that 368 accidents were recorded from the year of 2017 to 2019.

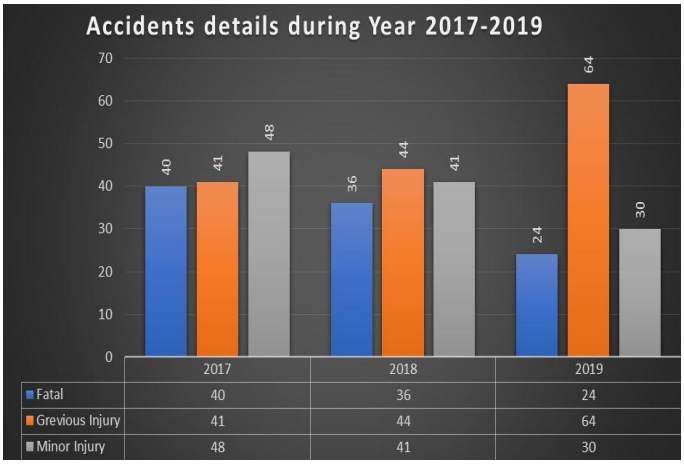

Fig -7: Accidents details during 2017-2019

- *Accidents by severity*

Based on accident data, the types of accidents were classified in to four categories and presented below

Table -3: Classification of accidents based on severity of accident

Type of Accident	Number of Accidents	% of Accidents
Fatal	100	27.17%
Grievous Injury	149	40.49%
Minor Injury	119	32.34%
Non-Injury	0	0.00%
Total	**368**	100.00%

- *Summary of Accidents/ Crash Analysis*

Table -4: Summary by type of accidents

Type of accident	Accidents	
	No.	% age
Overturning	61	16.6%
Head on collision	117	31.8%
Rear end collision	89	24.2%
Collision brush / side swipe	16	4.3%
Right angled collision	33	9.0%
Skidding	23	6.3%
Right turn collision	24	6.5%
Others	5	1.4%
Total accidents	**368**	**100.0%**

Table -5: Summary by road side features

Road Features	Accidents	
	No.	% age
Single lane	94	25.5%
Two Lanes	274	74.5%
Three lanes or more without central divider (median)	0	0.0%
Four lane for more with central divider	0	0.0%
Total accidents	**368**	**100.0%**

Table -6: Summary by road conditions

Road Condition	Accidents	
	No.	%
Straight road	146	39.67%
Slight curve	90	24.46%
Sharp curve	132	35.87%

- *Identifying Black spot locations based on MoRTH Protocol*

Blackspot were identified on few intervals as mentioned in below table.

Table -7: Identified Black spots on study stretch.

Sl No	Locations	Identification
1	05+500 – 6+000	Black spot
2	28+000 – 28+500	Black spot
3	43+500 - 44+000	Black spot
4	77+500 - 78+000	Black spot
5	78+000 - 78+500	Black spot
6	91+000 - 91+500	Black spot

7. DISCUSSIONS ON OUTPUTS

- **Loc-1:** Black spot location is marked as the most congestion location with religious structure (Data Sahab Temple) beside road edge. There are significant commercial activities surrounding this location. There are lots of parked vehicles along the road side due to religious structure, for which congestion creates on this location. There are significant movement of straight and U- turning vehicles with pedestrian movement at this location.
- **Loc-2:** Black spot location is marked as it 'Tee Junction" which diverts the traffic to Atru city. A spur connection of MDR-4 to state highway SH51 at the same location. It seems there is no installation of safety measures / road side furniture like signboard on this highly congestion Junction. The geometric and junction design for section is not as per the codal provision.
- **Loc-3:** Black spot location is marked at highly urban road in Kawai town which is highly congestion road, due to Kawai market on both side of the road, which makes the 2 lane road jam. The geometric deficiencies and improper intersection near residential areas is observed on this point of location.
- **Loc-4 & 5:** Black spot location is marked at Sarthal Ghati, it's a hilly and rolling terrain. Sharp curve were observed with no sight distance, inadequate shoulder width, inadequate lighting at night, non-existence of crash barriers for off-track vehicles. No safety features or road side furniture like signage, chevron, and hazard markers were not observed on this consecutive black spot location.
- **Loc-6:** Black spot location is marked at urban road in Aklera town which is highly congestion road, due to Aklera city market and residency on both side of the road, which makes the 2 lane road jam and accident prone area. The geometric deficiencies and improper intersection near residential areas is observed on this point of location. No safety measures like rumple strip were observed to reduce the speed of vehicle.
- **Description Road Safety Measures**

  Various considerations made for the safe design and the safety features included are summarized under following:

  - Alignment
  - Grade Separated Interchange
  - Intersection Arrangements, Underpasses
  - Road Signs, Pavement Marking & Lightings
  - Roadside Hazard
  - Roadside Communities & Facilities
  - Traffic calming measures during road construction

8. CONCLUSIONS

Most of the accidents were caused due to over speed and vehicle out of control and most of the accidents were taking place on straight road and sharp curve. The accidents happened due to fault of the drivers was because of drowsiness and slept of the drivers.

It is found that maximum numbers of accident were taking place at six locations, as mentioned in Chapter 5. However, the majorities of the literature shows that 77.5 % of road casualties recorded due to driver negligence's. Out of 368 accidents 100 fatal, 149 Grievous injury and 119 minor injury recorded during the analysis and accidents recorded due to weather condition, 157 were happened in fine weather condition and 59 were happened in very hot weather condition and 43 were happened in cold weather condition and other accident happened in light rain, mist, fog, etc.

Various safety elements considered in the geometric design of the NH and the road safety features incorporated in the report will address the safety engineering aspect of the national highway. During construction, the layouts proposed for various construction scenarios shall be strictly adhered as per IRC: SP-55 and the road signage's and road marking shall be adhered as per IRC-67 and IRC-35. The road safety features will be installed in such a way to make it as a "forgiving highway".

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BIOGRAPHIES

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