

BLACK SPOTS ANALYSIS ON PUNE - SOLAPUR NATIONAL HIGHWAY

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Abstract - Country like India with tremendous population requires excellent transportation system to grow. Transportation includes air transportation, land transportation, and water transportation. The door to door service is provided by land transportation hence it is having importance for development of country. By considering total length of roads, India is second largest city with 4,865,000 Km of total road length. Highways and expressways are considered as main vein for the development of country. Maharashtra is one of **the India's more advanced state and having relatively higher density of road network as well as motor vehicle as compared to other states.** Pune – Solapur National highway is a four lane highway connecting many of its major manufacturing center, commercial and cultural centers and is one of such highway which connects educational hub Pune with newly developing industrial corridor Solapur, Pune – Solapur highway having four lanes constructed and maintained by National Highway Authority Of India (NHAI). It has been observed form recent past numbers of fatal accidents are occurring on this highway because of which this highway becomes death trap. . Accidental black spot is the spots where accidents had occurred historically many times. Safety committee "**HAX COMMITTEE**" maintains record of accidents occurring on this highway. By using this secondary data with the help of various methods like severity index and ranking method accidental black spots analysis is done on Pune – Solapure national highway So by using such analysis the basic case of accidents can be identified and according to that the remedial measures may be adopted to improve the performance of highways.

Key Words: Accidental Black spot, National Highway, severity index, Ranking method.

1. INTRODUCTION

National highways and Expressways are considered as main veins for development of streets in the country [1]. The various reasons are responsible for the occurrence of accidents such as carelessness of driver, drunken driver, over confidence, violation of traffic rules, time of accidents,

age of driver, location of accident overspeeding, rear end collision, collision brush, skidding, absence of guard stones or indicators on the curve etc.because of increase in speed and reduction of travelling time the number of accidents on the roads are increase considerably and result in death and injuries of various peoples travelling of the roads. The rate of accident is directly proportional to the vehicle population [2].It has been noticed that on an average 180 persons died and 900 are injured in the road accidents every day [3]. The fatalities of road accidents have increases from 64,000 in year 1994 to 85,000 in year 2011. National highway carries 40% of goods traffic; state highway carries 30% of goods traffic [3]. The national highway through contribute only 20% of the road network,25% of road accident occur on them out of which 34% lead to fatalities and 28% to serious injuries [3].

2. ACCIDENTAL SCENARIO OF HIGHWAYS IN INDIA

Statistical analysis shows that in 2013 alone 1, 40,000 people were killed and close to 5, 00,000 were seriously injured or permanently disabled in road accidents. The spastics of road crash death of top 10 states in India is debited in figure.1

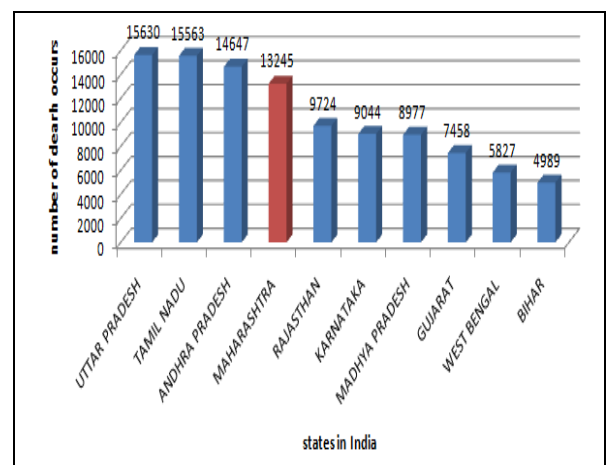


Figure-1: Road Crash Deaths of Top 10 States in India.

From figure it is cleared that the in Uttar Pradesh highest number of death occurred where as less number of deaths occurred in Bihar. Maharashtra having the forth rank in occurrence of deaths among 10 cities

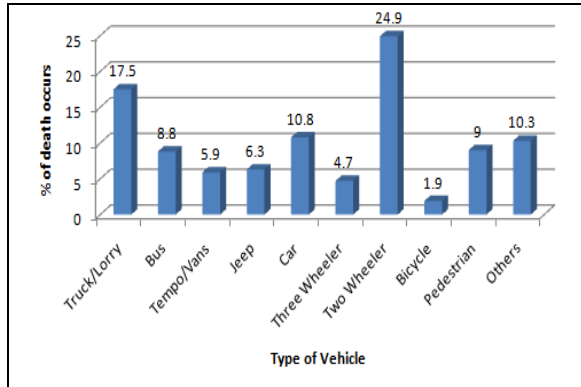


Figure-2: Statistical analysis of type of Vehicle responsible for Accidents.

From figure 2. it is cleared that the vehicle with highest share of fatalities to occupant is two wheeler 24.9 %, truck/lorry have the second highest 17.5 % involvement in accidents. Car constitutes 10.8 % of affected persons followed by others 10.3%. Pedestrians account for 9 % of accidents etc.

3. RATIONALE AND SIGNIFICANCE OF THE STUDY

An accident black spot is a term used in road safety management to denote a place where road traffic accidents have historically been concentrated. Bureau of Transport and Regional Economics of Australia (2001) locations are in general classified as black spots after an assessment of the level of risk and the likelihood of a crash occurring at each location [4]. Usually it is observed that accidents seem to be concentrated at particular location which is recognized as accident prone location/black spot. According to Hauer (1996), some researchers rank locations for determining black spots by accident rate (accidents per vehicle-kilometers vehicles), some use accident frequency (accidents per km-year or accidents per year) and some use a combination of the two [5]. The accidental prevention committee (APC) inspected total 18027 km length on National Highway and state highway and identified 7313 accident prone spots in India [6].

Due to road accidents there is occurrence of high social, economical and socio-economic cost of the fatalities and injuries hence, there is palpable necessitate of effective measures and policies for restriction of road accidents make it essential to study the causes of road accidents.

The various terms regarding road accidents are explained below;

Fatal injury: An accident that involving at least one death. Any victim/person that dies within 30 days of the accident is termed as fatal injury.

Grievous Injury: An accident with no death/ fatalities but at least one or two victim/person hospitalized more than 1 day.

Minor injury: An accidents in which victim suffer minor injuries which are treated as first-aid or or in hospital as an outpatient.

No injury: An accident in which no injuries are sustained by any of the involved person. Usually only vehicle damage occurs as a result of the accidents.

4. STUDY AREA

The map of the Pune –Solapur National Highway is shown in figure 3. the Pune –Solapur Highway is a controlled accessed Highway. It is a four lane roadway with a speed limit of 100 Km/hr along most of its stretches. For present study Km 40- Km 50 has been selected total 25 accidents occurred on Pune Solapur highway from 2014 to 2015 in that particular stretch.

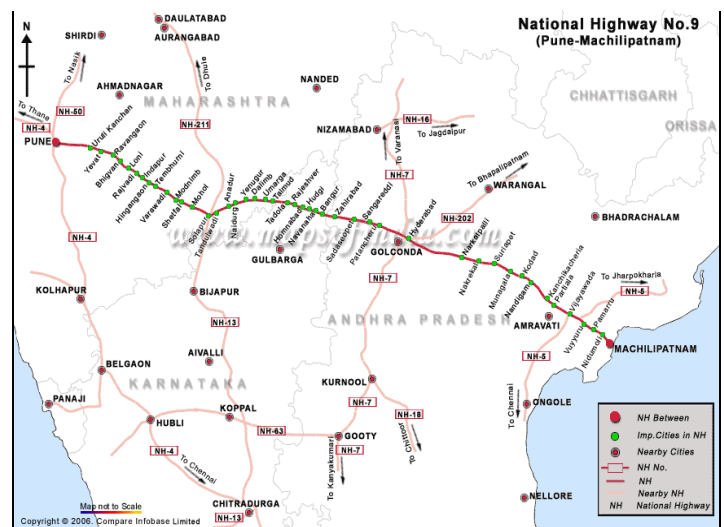


Figure-3: Map of Pune – Solapur National Highway.

5. METHODOLOGY OF THE STUDY

Identification of accidental black spot is the procedure to find spots that are particularly dangerous where accidents had occurred historically in this study the identification of such hazardous locations are done based on accidental record available about location of accident, nature of accident, causes of accidents and classification of accidents and others by using various method like ranking and

severity index. The methodology suggested for study includes;

- To collect accident data on Pune Solapur National Highway from National Highway Authority of India.
- Detailed analysis of the identified black spots.
- To find out different methods to prioritize hazardous locations.
- To identify various traffic and road related factors causing accidents.
- The reading taken on Pune-Solapur National Highway then analyzed by method of ranking. According to importance of the parameter.
- The most important parameter because of which more number of accidents is occurred had given top rank and maximum weightage.
- Analysis of the top ranked accidental spots.
- The percentages after giving rank and weightage were calculated and on the basis of value of percentage the accidental black spots were identified.

6. EXPERIMENTAL INVESTIGATIONS

For experimental investigation on Pune – Solapure National Highway Km 40 – Km 50 was select as a pilot study. The methodology consists of analysis of contributing factors for 25 accidents that occurred on the Pune – Solapure highway during 5 consecutive months resulted in fatal or Grievious injury.

The accidental observations for Pune-Solapur National Highway are given in Table 1, Table 2, and Table 3 for Nature of accidents, classification of accidents and causes of accidents respectively.

LEGENDS

A:Accident Location: 1.Chainage

B: Nature of Accident:

1-Overturning, 2-Head on collision, 3-Rear end collision,4-Collision brush, 5-Right turn collision, 6-Skidding,7-Absence of guard stone or curve indicator on the curve.

C: Classification of Accident:

1-fatal,2-Grievious Injury,3-minor Injured,4-Non Injured.

D:Causes of accident:

1-Drunken,2-overspeeding,3-vehicle out of control,4-fault of driver of motor vehicle/driver of other vehicle,5-Defect in mechanical condition of motor

Sr No.	Accident Location (Km)	Nature of Accident									
		A							B		
		1	2	3	4	5	6	7	severity	SI (%)	
1	40.000	N	N	Y	N	N	N	N	6	21.42	
2	41.000	N	N	N	N	N	Y	N	5	17.85	
3	41.500	N	N	Y	N	N	N	N	6	21.42	
4	43.700	N	N	Y	N	N	N	N	6	21.42	
5	44.300	N	N	Y	N	N	N	N	6	21.42	
6	44.350	N	N	N	Y	N	N	N	3	10.71	
7	44.450	Y	N	N	N	N	N	N	7	25	
8	44.750	Y	N	N	N	N	N	N	7	25	
9	45.500	N	N	N	N	N	Y	N	5	17.85	
10	46.100	N	N	Y	N	N	N	N	6	21.42	
11	46.200	N	N	N	N	N	Y	N	5	17.85	
12	46.600	Y	N	N	N	N	N	N	7	25	
13	46.600	N	N	N	Y	N	N	N	3	10.71	
14	47.300	Y	N	N	N	N	N	N	7	25	
15	47.300	N	N	N	N	N	Y	N	5	17.85	
16	47.600	Y	N	N	N	N	N	N	7	25	
17	47.700	Y	N	N	N	N	N	N	7	25	
18	47.700	N	N	Y	N	N	N	N	6	21.42	
19	48.150	N	Y	N	N	N	N	N	4	14.28	
20	48.150	N	N	Y	N	N	N	N	6	21.42	
21	48.400	N	Y	N	N	N	N	N	4	14.28	
22	48.400	Y	N	N	N	N	N	N	7	25	
23	48.400	Y	N	N	N	N	N	N	7	25	
24	48.630	N	Y	N	N	N	N	N	4	14.28	
25	49.350	N	N	N	N	N	N	Y	2	7.14	
	Yes	8	3	7	2	0	4	1			
	Ranking	1	4	2	5	7	3	6			
	weigh	7	4	6	3	1	5	2	28		
	severity index benchmark	Benchmark								21.4	

SrNo	Accident Location (Km)	Classification of Accident						SrNo	Accident Location (Km)	Causes						
		C								D						
	A	1	2	3	4	severity	SI (%)		A	1	2	3	4	5	severity	SI (%)
1	40.000	N	Y	N	N	2	20	1	40.000	Y	N	N	N	N	3	20
2	41.000	N	N	N	Y	3	30	2	41.000	N	Y	N	N	N	5	33.33
3	41.500	N	N	Y	N	4	40	3	41.500	N	N	N	Y	N	2	13.33
4	43.700	N	Y	N	N	2	20	4	43.700	N	Y	N	N	N	5	33.33
5	44.300	N	N	N	Y	3	30	5	44.300	N	N	Y	N	N	4	26.66
6	44.350	N	N	N	Y	3	30	6	44.350	N	Y	N	N	N	5	33.33
7	44.450	N	N	N	Y	3	30	7	44.450	Y	N	N	N	N	3	20
8	44.750	N	Y	N	N	2	20	8	44.750	N	Y	N	N	N	5	33.33
9	45.500	N	N	Y	N	4	40	9	45.500	N	N	Y	N	N	4	26.66
10	46.100	N	N	Y	N	4	40	10	46.100	N	N	Y	N	N	4	26.66
11	46.200	N	N	N	Y	3	30	11	46.200	N	N	Y	N	N	4	26.66
12	46.600	N	N	Y	N	4	40	12	46.600	N	Y	N	N	N	5	33.33
13	46.600	N	N	Y	N	4	40	13	46.600	Y	N	N	N	N	3	20
14	47.300	N	N	Y	N	4	40	14	47.300	N	Y	N	N	N	5	33.33
15	47.300	N	Y	N	N	2	20	15	47.300	N	Y	N	N	N	5	33.33
16	47.600	N	N	N	Y	3	30	16	47.600	N	N	Y	N	N	4	26.66
17	47.700	N	N	N	Y	3	30	17	47.700	N	N	Y	N	N	4	26.66
18	47.700	N	N	N	Y	3	30	18	47.700	N	Y	N	N	N	5	33.33
19	48.150	N	N	Y	N	4	40	19	48.150	N	N	N	N	Y	1	6.66
20	48.150	N	Y	N	N	2	20	20	48.150	Y	N	N	N	N	3	20
21	48.400	N	N	Y	N	4	40	21	48.400	Y	N	N	Y	N	2	13.33
22	48.400	N	N	Y	N	4	40	22	48.400	N	Y	N	N	N	5	33.33
23	48.400	Y	N	N	N	1	10	23	48.400	N	Y	N	N	N	5	33.33
24	48.630	N	N	N	Y	3	30	24	48.630	N	N	N	Y	N	2	13.33
25	49.350	N	N	Y	N	4	40	25	49.350	N	N	Y	N	N	4	26.66
	Yes	1	5	10	9				Yes	5	0	7	3	1		
	Ranking	4	3	1	2				Ranking	3	1	2	4	5		
	Weightage	1	2	4	3	10			weightage	3	5	4	2	1	15	
	severity index benchmark						30			severity index benchmark						20

$\alpha_1, \alpha_2, \alpha_3 \dots \alpha_{10}$ = total number of Ys for parameters 1, 2, 3...7 respectively.

6.1 Sample Calculation

The sample calculations for km 43.700 for nature of accidents

- Consider chainage 43.700 from Table .1
- Parameter 3 i.e “Rear end Collision” was found and hence marked as Y (YES).
- Parameter 1 i.e “overturning” was absent and hence marked as N (NO).
- Accordingly all the parameters for all the chainages were marked as Y or N.

6.2 Analysis Of Data

Method adopted for analysis is called as Ranking Method.

This method determines the vulnerability of a particular spot to accidents. It finds the most predominant parameter out of the available. It is based on logical analysis wherein the parameter occurring most frequently is given the top rank and the parameters that have occurred rarely are given lower ranks. Ranks given to different parameters are applicable to that particular study area only.

1. Method of ranking.

- For all the 7 parameters, the number of chainages denoting Y were calculated (Say α). Refer TABLE 2
- The parameters were ranked on the basis of the number of Ys. The one with most number of Ys was given the top rank.
- The parameters were given the weightages on the basis of their ranks. The one with top rank was given the highest weightage.

Sample Calculations,

Referring to TABLE 1.

α = total number of Ys for a particular parameter.

Therefore, $\alpha_1 = 5Y$

$\alpha_2 = 1Y$

$\alpha_3 = 10Y$

.

.

$\alpha_7 = 4Y$

Out of 7 parameters, rear end collision was present at 10 spots and it was given the top rank and the highest weightage (4) as shown in TABLE 1

Table 2: Assigning Ranks And Weightages To Chosen Parameters

Parameter s	Denot ation	α	Rank	Weightag e
Overturnin g	α_1	8Y	1	7
Head on collision	α_2	3Y	4	4
Rear end collision	α_3	7Y	2	6
Collision brush	α_4	2Y	5	3
Right turn collision	α_5	0Y	7	1
Skidding	α_6	4Y	3	5
Absence of guard stone or curve indicator on the	α_7	1Y	6	2

curve				
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$$100 - [(22/28) \times 100] = 21.42$$

2. Severity Index

Severity Index denotes vulnerability of a particular spot to accidents.

i. Severity (β) was calculated by adding respective weightages of the parameters indicating Y for a particular chainage. Refer TABLE 1

ii. Severity Index (SI) was calculated as shown below;

$$SI = (\beta / \Sigma W) \times 100$$

Where,

$$\Sigma W = w_1 + w_2 + \dots + w_{10}$$

iii. Sample calculation

Referring to TABLE 1

Consider chainage 46.600

Severity $\beta = 6$

Severity Index $SI = (\beta / \Sigma W) \times 100$

$$\begin{aligned} \Sigma W &= 7+6+5+4+3+2+1 \\ &= 28 \end{aligned}$$

$$\begin{aligned} \text{Severity Index SI} &= (7 / 28) \times 100 \\ &= 25 \% \end{aligned}$$

iv. Severity Index Benchmark:

Severity index benchmark is the severity index value above which corresponding spots are black spots.

It is calculated as the sum of weightages assigned to the top 5 parameters divided by weightage of all the parameters. The value obtained in % is then subtracted from 100 to obtain Severity Index Benchmark

For e.g.: Summation of the weightages assigned to top 5 parameters

$$7+6+5+4 = 22$$

$$\text{Weightage of all parameters} = 28$$

$$\text{Severity Index Benchmark} =$$

Based on analysis of data profile indicating severity Vs actual chain age is present in figure 4, figure 5, figure 6 for Nature of accidents, classification of accidents and causes of accidents respectively.

- From figure 4 it has been cleared total 8 accidental spots are above the datum of severity index of 21.42 with the parameter nature of accident which clearly indicate that the presence of accidental black spot.
- From figure 5 it has been cleared total 10 accidental spots are above the datum of severity index 30 with classification of accidents which clearly indicate that the presence of accidental black spots.
- From figure 6 it has been cleared total 17 accidental spots are above the datum of severity index 20 with causes of accidents which clearly indicate that the presence of accidental black spots.

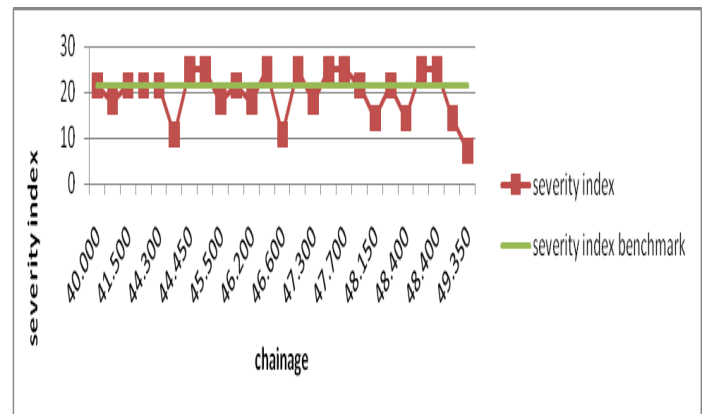


Figure-4 Profile Showing Severity Vs Actual Chainage for Nature of Accident.

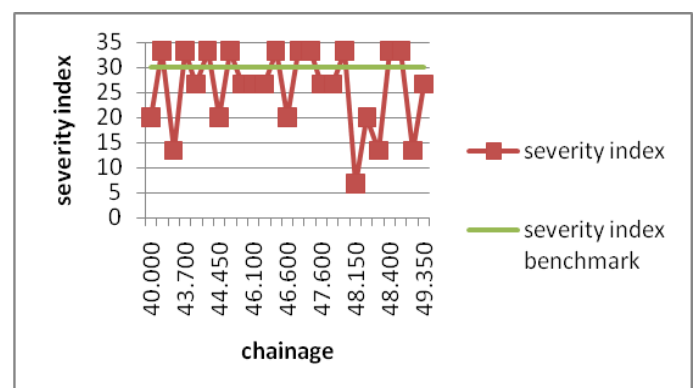


Figure-5 Profile Showing Severity Vs Actual Chainage for Classification of Accidents.

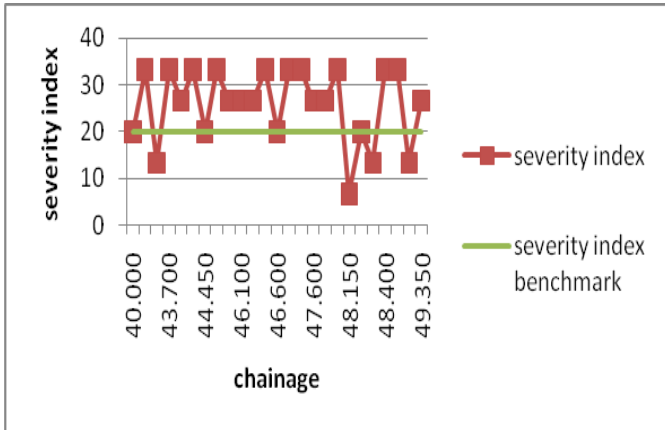


Figure-6 Profile Showing Severity Vs Actual Chainage for Causes of Accidents.

7. CONCLUSIONS

- By considering all these parameters by using method of ranking and severity index the accidental black spots can be identified.
- More number of accidents were occurred due to causes of accidents followed by classification of accidents and least number of accidents are occurred due to nature of accidents.

8. ACKNOWLEDGEMENT

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Working as a Assistant Professor and Post Graduation (C&M) student in RMD Sinhgad School of Engineering. Completed B.E civil form Vidya prathisthans college of engineering Baramati, Having total 3 years teaching experience. Published more than 4 international/national papers in journal and conference.



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