International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Accidental Study on Pune - Solapur National Highway

Snehal U Bobade[1], Jalindar R Patil[2]

[1, 2]Savitribai phule Pune University, Department of Civil Engineering,
RMD Sinhgad School of Engineering, Warje,Pune-411058, (MS), India

Abstract: ***National highways are considered as main veins for the development of country. It has been observed that more than 13 peoples are dying in the road accidents per hour all over the world. According to the world health organization (WHO), in its global status reports on road safety (2013), observers that road traffic injuries "the leading cause of death for young people aged 15-29". Government of India formulated Accidental Prevention Committee (APC) in the year 1997 for identifying accidental prone spots on the rural highways of the state and suggested the suitable remedial measures for reducing the accidents. In Maharashtra state Pune - Solapur highway witnessed large number of accidents since they became fully operational. According to road safety management the place where road traffic accidents have historically been concentrated is termed as an accidental black spot. While designing and planning of Pune - Solapure Highway the vision may be to construct accident free Highway and normal causes of accidents were properly taken into consideration. . Still numbers of accidents have occurred in resent past daily on national highways. Pune – Solapur highway 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. Safety committee" HACK COMMITTEE" maintains record of accidents occurring on this highway. In present study the data of accidents on Pune Solapure highway has been collected. The various parameters responsible for accidents are categorized as accident location, nature of accidents, classification of accidents, causes of accidents and others. The papers include study and identification of accidental black spot on National Highways on above parameters by using method of ranking and severity index method, Accidental density method and weighted severity index method.***

Keywords: Accidental Black Spots, National Highways, Severity Index.

1. Introduction

Maharashtra is a state in the western region of India. It is the second most popular and third largest state by area in India. Maharashtra is the world's second most popular first level administrative country.

Pune is the second largest city in Maharashtra and seventh largest city in India. Pune is the cultural and heritage capital with population of 4.5 million people. Pune is connected to Mumbai – Pune Expressway. Pune is a major information technology hub of India as well as a foremost destination for automobile manufacturing and the component industry.

Mumbai is financial, administrative and commercial capital of Maharashtra. In Mumbai there is large number of cotton textile industry and it is one of the busiest airports in India. Due to administration, urbanization and education Pune is fast changing it's characteristics and become most important industrial hub. Mumbai is India's link to the world of telecommunication and the internet.

An accidents are such happenings resulting in injury that is in no way the fault of the injured person for which compensation or indemnity is legally soughts.Road accidents are happen due to carelessness ,high speed of vehicle, driver taking liquor (alcohol),human tendency, age group, violation of rules, time of accidents. The major reason behind vehicles and condition of vehicle using road.

Accidents are the most important negative impact of transportation system and it is complex flow pattern of vehicular traffic, presence of mixed traffic along with pedestrians. Traffic accidents leads to loss of life and property. The road traffic accidents cannot be totally prevented but by suitable measures they can reduced to certain extent. For that purpose systematic study of road accidents are required to be help of providing preventive measures like design and control.

2. Rationale and Significance of the Study

An accident is any event that happens unexpectedly without a deliberate plan or cause. There are three main factors responsible for accident human [speeding (30%), falling asleep (29%) ,drinking, violation of traffic rules, lack of seat belt(46%)],vehicle[speed of vehicle, condition of vehicle using road] and infrastructure[roadside man made structure (28%),passenger pickup shades(73%)].

Road parameters such as road width, width of shoulder superelevation,sightdistance,absence of guard stone or curve indicator on the curve, straight road, sharp curve, steep incline, erosion of shoulders, divider cuts, junction at the road.

This paper deals with study of such accidental prone areas by considering various parameters such as accident location, nature of accident, road features, road conditions, intersection on type and control and others. The studies consist of analysis of contributing factor for accidents that happened on Pune-Solapur Highway over consecutive years. A second analysis was conducted for those 28 accidents result in a Fatal or Grievous injury.

Licensed Under Creative Commons Attribution CC BY

Injury Severity Definition:

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

3. Brief overview of the literature

Srinivas Rao. B et al (2005), conducted an accident study on NH - 5 Between Anakapalli to Visakhapatnam during the year 2003 and it runs through urban, semi urban and rural areas.

M Patel et al.conducted an accidental study on Mumbai – Pune Expressway by considering human, vehicle and infrastructural factor and combination of these factors responsible for accidents out of that 57% of accidents are occurred due to human alone,16.5% vehicle factor alone, 1% infrastructural factor,22.5% of accident was happened due to combination of human and infrastructure,16.5% occurred due to combination of human and vehicle and 1% occurred due to combination of vehicle and infrastructure. Out of 214 accidents happened on Mumbai-Pune Expressway 68 accidents involved fatal or serious injury. The distribution of contributing

Wichuda kowtanapanich, conducted Black spot identification method in Thailand by using both conventional method and public participation method to identify the Black spot locations.Vishrut landge et.al (2013), conducted accidental study on NH -58 connecting New Delhi to Mane by using back coefficient Method and Multiple regression technique. Meeghat Habibian et al. (2011), identify and rank hazardous road location in two way rural roadsby considering statistical analysis and micro-simulation modeis and identify the ranking of high risk road Iljoon Chang and Seong W. Kim (2011), in their study use Bayesian Approach with a Poisson Mixture Model for Identifying Accident-Prone Spots. During their study they consider a mixture of the zero-inflated Poisson and the Poisson regression models to analyze zero-inflated data sets drawn from traffic accident studies. They also perform simulation study and real data analyses are performed to demonstrate model fitting performances of the proposed model. This study attempt at identifying accidental black spots by arranging the parameters causing accidents on the basis of their severity, ranks are given to each and every parameter and by calculating the percentage the accidental black spots are identified.

4. Aims and Objective

The basic aim of study is to identify accidental black spot on National Highway and Expressway by considering different parameters such as accident location, nature of accident, road features, road condition, intersection of type & control and others by calculating the severity index.

5. Methodology of Study

- The study is divided into two main steps 1st collection of accidental data from police station and National Highway Authority of India (NHAI) 2nd onside investigation.
- In field investigation, road length is divided into suitable chainage.
- Comparison of real time data which is obtained from site investigation with the record available in police station.
- Identify various Engineering (traffic and road related) factors causing accidents.
- The analysis of data is done and accidental prone locations are identified by method of ranking and severity index.

6. Experimental Investigation

The basic aim of study is to identify accidental black spot on for experimental investigation on Pune –Solapure Highway km 50-60 was selected as pilot study. According to statistic provided by National Highway Authority of India (NHAI) this portion of highway has witnessed maximum accidents in last 5 months. The observations are taken by considering various parameters responsible for occurrence of accidents. The observations are present in Table 1.

Legends:

Table 1: Observation table for Identification of Black Spots on National Highway.

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	50.25	Y	N	N	N	N	N	N	6	21.42
2	51.2	N	N	Y	N	N	N	N	7	25
3	51.2	N	N	Y	N	N	N	N	7	25
4	51.9	N	N	N	N	Y	N	N	2	7.14
5	51.9	N	N	Y	N	N	N	N	7	25
6	52	N	N	Y	N	N	N	N	7	25
7	52.25	N	N	Y	N	N	N	N	7	25
8	52.45	N	N	Y	N	N	N	N	7	25
9	53.35	N	N	N	N	N	Y	N	4	14.28
10	53.7	N	N	Y	N	N	N	N	7	25
11	53.75	Y	N	N	N	N	N	N	6	21.42
12	54.2	N	N	N	N	N	Y	N	4	14.28
13	54.53	Y	N	N	N	N	N	N	6	21.42
14	54.9	Y	N	N	N	N	N	N	6	21.42
15	55.8	N	N	N	N	N	N	Y	5	17.85
16	56.1	Y	N	N	N	N	N	N	6	21.42
17	56.55	N	N	Y	N	N	N	N	7	25

Licensed Under Creative Commons Attribution CC BY

18	56.75	N	N	N	N	N	N	Y	5	17.85
19	57.15	N	N	Y	N	N	N	N	7	25
20	57.2	N	Y	N	N	N	N	N	3	10.71
21	57.2	N	N	Y	N	N	N	N	7	25
22	58.7	N	N	N	N	N	N	Y	5	17.85
23	58.75	N	N	Y	N	N	N	N	7	25
24	58.8	Y	N	N	N	N	N	N	6	21.42
25	59.1	N	N	N	N	N	N	N	1	3.57
26	59.1	N	N	Y	N	N	N	N	7	25
27	59.2	N	Y	N	N	N	N	N	3	10.71
28	29.35	N	N	N	N	N	Y	N	4	14.28
29	59.36	N	N	N	N	N	N	Y	5	17.85
Yes		6	2	12	0	1	3	4		
Ranking		2	5	1	7	6	4	3		
Weightage		6	3	7	1	2	4	5	28	
Severity Index Benchmark benchmark									21.42	

Sr.No	Accident Location (Km)	Classification of Accident					
	A	C					
		1	2	3	4	Severity	SI(%)
1	50.250	N	N	N	Y	3	30
2	51.200	N	N	N	Y	3	30
3	51.200	N	N	Y	N	3	40
4	51.900	N	N	Y	N	4	40
5	51.900	N	N	N	Y	3	30
6	52.000	N	N	N	Y	3	30
7	52.250	N	N	Y	N	4	40
8	52.450	N	N	Y	N	4	40
9	53.350	N	N	Y	N	4	40
10	53.700	N	N	N	Y	3	30
11	53.750	N	N	N	Y	3	30
12	54.200	N	N	Y	N	4	40
13	54.530	N	N	N	Y	3	30
14	54.900	N	Y	N	N	2	20
15	55.800	N	Y	N	N	2	20
16	56.100	N	N	Y	N	4	40
17	56.550	N	N	Y	N	4	40
18	56.750	N	N	Y	N	4	40
19	57.150	N	N	Y	N	4	40
20	57.200	Y	N	N	N	1	10
21	57.200	N	Y	N	N	2	20
22	58.700	N	N	N	N	3	30
23	58.750	N	N	Y	N	4	40
24	58.800	N	N	Y	N	4	40
25	59.100	N	N	N	N	3	30
26	59.100	N	N	Y	N	4	40
27	59.200	N	N	N	Y	3	30
28	29.350	N	N	Y	N	4	40
29	59.360	N	Y	N	N	2	20
	YES	1	4	14	8		
	Ranking	4	3	1	2		
	Weightage	1	2	4	3	10	
severity index Benchmark							30

Sr No	Accident Location (Km)	Causes						
	A	D						
		1	2	3	4	5	Severity	SI (%)
1	50.250	N	N	N	Y	N	5	33.33
2	51.200	Y	N	N	N	N	1	6.66
3	51.200	N	Y	N	N	N	4	26.66
4	51.900	N	N	N	Y	N	5	33.33
5	51.900	N	N	N	N	Y	2	13.33
6	52.000	N	N	Y	N	N	3	20
7	52.250	N	N	N	Y	N	5	33.33
8	52.450	N	Y	N	N	N	4	26.66
9	53.350	N	N	Y	N	N	3	20
10	53.700	Y	N	N	N	N	1	6.66
11	53.750	N	N	N	Y	N	5	33.33
12	54.200	N	N	Y	N	N	3	20
13	54.530	N	Y	N	Y	N	5	33.33
14	54.900	N	Y	N	N	N	4	26.66
15	55.800	N	N	N	N	Y	2	13.33
16	56.100	N	N	Y	N	N	3	20
17	56.550	N	Y	N	N	N	4	26.66
18	56.750	N	N	N	Y	N	5	33.33
19	57.150	N	N	N	Y	N	5	33.33
20	57.200	N	N	N	Y	N	5	33.33
21	57.200	N	Y	N	N	N	4	26.66
22	58.700	N	N	N	Y	N	5	33.33
23	58.750	N	Y	N	N	N	4	26.66
24	58.800	N	N	Y	N	N	3	20
25	59.100	N	N	N	N	Y	2	13.33
26	59.100	N	N	N	Y	N	5	33.33
27	59.200	Y	N	N	N	N	1	6.66
28	29.350	N	N	Y	N	N	3	20
29	59.360	N	N	N	N	Y	2	13.33
	YES	3	7	6	10	4		
	Ranking	5	2	3	1	4		
	Weightage	1	4	3	5	2	15	
	Severity Index Benchmark						20	

A: Sample calculation for Km 53.700 for Nature of accidents

a) Consider chainage 53.700 from Table .1
b) Parameter 3 i.e "Rear end Collision" was found and hence marked as Y (YES).
c) Parameter 1 i.e "overturning" was absent and hence marked as N (NO).
d) Accordingly all the parameters for all the chainages were marked as Y or N.

B: Analysis

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.

C. 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.
α1, α2, α3... α7 = total number of Ys for parameters 1, 2, 3…7respectively.
Therefore, α1 = 6Y
α2 = 2Y
α3 = 12Y

Licensed Under Creative Commons Attribution CC BY

.
.
.
α7= 4Y

Out of 7 parameters, rear end collision was present at 12 spots and it was given the top rank and the highest weightage (7) as shown in TABLE 1.

Table 2: Assigning Ranks And Weightages To Chosen Parameters

Parameters	Denotation	α	Rank	Weightage
Overturning	α1	6Y	2	6
Head on collision	α2	2Y	5	3
Rear end collision	α3	12Y	1	7
Collision brush	α4	0Y	7	1
Right turn collision	α5	1Y	6	2
Skidding	α6	3Y	4	4
Absence of guard stone or curve indicator on the curve	α7	4Y	3	5

2. Severity Index

Severity Index denotes vulnerability of a particular spot to accidents

a) Severity (β) was calculated by adding respective weightages of the parameters indicating Y for a particular chainage. Refer TABLE 1
b) Severity Index (SI) was calculated as shown below;
SI = (β/ ΣW) x 100
Where,
ΣW= w1+w2+…+w10
c) Sample calculation for nature of accidents.
Referring to TABLE 1
Consider chainage 56.750
Severity β = 5

Severity Index
SI = (β/ ΣW) x 100
ΣW= 7+6+5+4+3+2+1 = 28
Severity Index **SI =** (5/ 28) x 100 = 33.33 %

A. 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 parameter
7+6+5+4= 22
Weightage of all parameters= 28
Severity Index Benchmark= 100- [(22/28) x 100] = 21.42

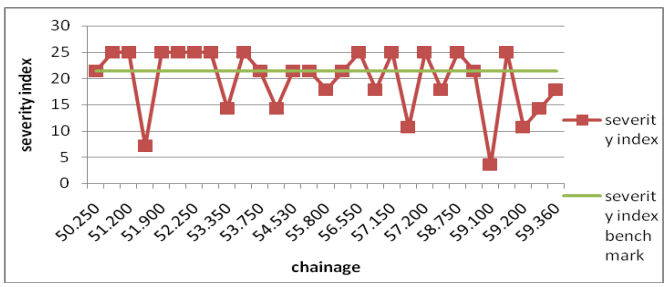


Figure 1: Profile Showing Severity Vs Actual Chainage for Nature of Accident

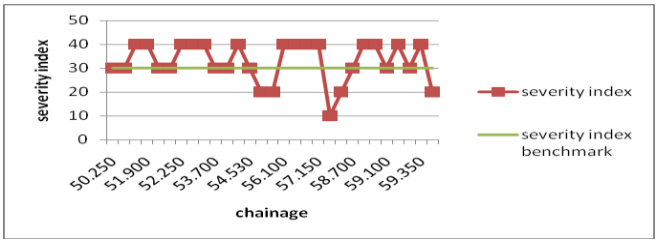


Figure 2: Profile Showing Severity Vs Actual Chainage for Classification of Accidents

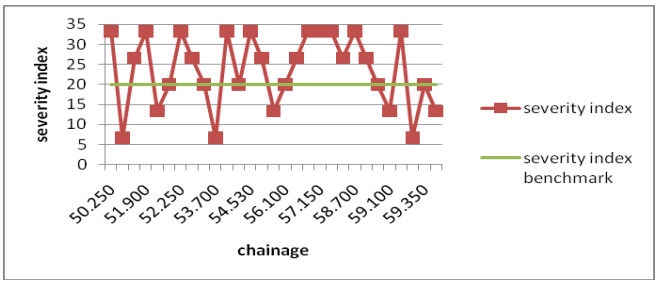


Figure 3: Profile Showing Severity Vs Actual Chainage for Causes of Accidents

B. Accident Density Method

1) The accident density is calculated from the number of accidents per unit length for a section of highway. Sections with more than a predetermined number of accidents are classified as high accident locations.
2) Unit length is taken as 1000m.
3) Predetermined no. of accidents is calculated as average number of accidents that have occurred per unit length.

Average no. of accidents = (Total no. of accidents) / 29
Per unit length
Sample calculation,
Average no. of accidents = (29) / (10) = 2.9

Per unit length

Every 1000 m length of the stretch where no.accidents is more than 2.9 is termed as accidental black spot.

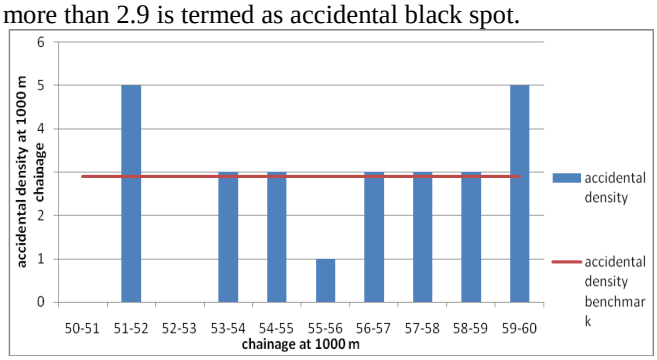


Figure 4: Accidental Density Method.

C. Weighted Severity Index (WSI)

1) WSI follows a system of assigning scores based on the number and severity of accidents at that particular location.
2) Severity of an accident is classified as Fatal(K), Grievous injuries (GI) and minor injuries (MI).

Licensed Under Creative Commons Attribution CC BY

3) WSI is calculated by following formula, WSI = (41 x K) + (4 x GI) + (1 x MI)
4) Locations having WSI above 40 are termed as accident black spots.
5) Criteria for choosing limit of WSI

In the WSI formula a fatal accident has been given 10.02 times more weightage than grievous accident (4<<41) also minor accident has been given a unit coefficient. (1<<41). For grievous and minor accidents to be comparable with fatal accidents while calculating WSI more data is required and hence in this specific research limit of WSI is chosen as 41 i.e. coefficient of K.

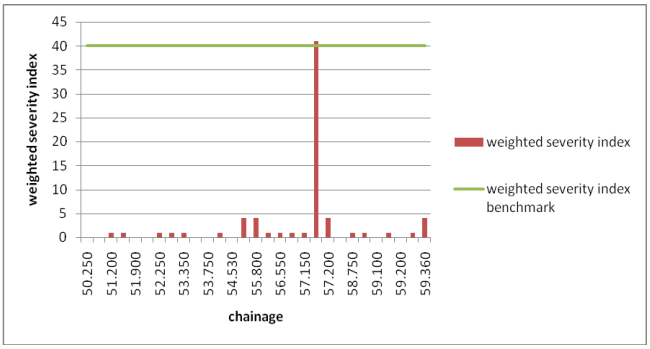


Figure 5: Weighted Severity Index

7. Result and Discussions

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 are occurred had given top rank and maximum weightage. The percentages after giving rank and weightage were calculated and on the basis of value of percentage the accidental black spot was identified.

1. From figure 1,2,3 it has been cleared total **12,14,16 spots** are above the datum of severity index with nature of accident, classification of accidents and causes of accidents respectively which clearly indicate that the presence of accidental black spot.
2. Graph 4 shows the comparison between accident densities at different chainages. X-axis shows the actual chainage whereas Y-axis shows accident density per 1000 m chainage. Red line is the limit line. Accident density per 1000 m more than 2.9 is considered as very high.
3. Graph 5 shows the variation of WSI along the study area. WSI exceeding 40 is considered as very high .

It has been concluded that by considering all these parameters the accidental black spots can be identified by 3 methods. More number of accidents are occurred due to causes of accidents followed by classification of accidents and least number of accidents are occurred due to nature of accidents.

References

[1] S.U Bobade, J.R.Patil, R.R.Sorate (2015), International Journal of Research in Advent Technology (IJRAT), Vol.3 Issue 2.
[2] A.N Dehuri, A.K.Das, A.K.Pattnaik, U.Chattraj, P.Bhan, M.Panda (2013), International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622, Vol.3, Issue 3 pp-402-408
[3] Vishrut Landge, A.K.Sharma (2013), International Journal of Chemical, Environment & Biological Sciences (IJCEBS), ISSN 2320-4087, Vol.1, Issue 2.
[4] Bureau of Transport and Regional Economics of Australia (2001).
[5] Annual Transport Conference at Aalborg University 2007N 1903-1092.
[6] A.D.Thube, D.T.Thube (2010), Inter National Journal Of Civil Engineering and Technology (IJCIET), ISSN 0976-6308, Vol.1.
[7] Report on Accidental Prevention Committee (2001), Public Work Department, Government of India.
[8] Accidents studies lecture notes in Traffic Engineering & Management (Feb. 19, 2014).
[9] Accidents study on National Highway -5 between Anakapalli to Vishakhapatnam by B.Srinivas Rao, E. Madhy, Santosh Jalihal, T.S. Reddy.

References



Snehal U. Bobade is working as 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.



Dr. Jalindar R. Patil is working as Professor and Head of Department in RMD Sinhgad School of Engineering. He is B.E., M.E., Ph.D. (Engg.: Civil-Geotech, NIT Warangal) ,MISSMGE, FIGS, MIRC, MISTE, MISRMT, having Teaching and administrative experience of 24 years and 3.5 years of experience of Research, published more than 35 international/national papers in journal and conference, received 3 merits and award at national level

Licensed Under Creative Commons Attribution CC BY