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IDENTIFICATION OF ACCIDENT BLACK SPOTS ON NATIONAL HIGHWAY

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Abstract: Transportation is responsible for the development of civilizations from very old times by meeting travel requirement of people and transport requirement of goods. In today's world, road and transport has become an integral part of every human being. However it is observed that fatalities have shot up by half in the last 10 years About 1.2 million Indians were killed in car accidents over the past decade, on average one every four minutes, while 5.5 million were seriously injured. In India National highways comprise 1.7% of total road network, but carry about 40% of road traffic which contribute to 29% of total road traffic accidents. The 34-km stretch of Mumbai-Bangalore highway in the Pune city limits has seen 110 fatal accidents in the last three years claiming 111 lives. Thus the primary aim of the project is to identify the accident black spots on National Highway-4 spanning 14.5Kms from New Katraj Tunnel to Chandani Chowk and to suggest remedial measures. The project concentrates on infrastructure errors and their combination with other types. An accident black spot is a term used in road safety management to denote place where road traffic accidents have been historically been concentrated. For finding out various causes of accidents, different methodologies adopted and to find out remedial measures, international journal papers were referred. Methodology adopted includes collecting the secondary data from respective authority, conducting physical survey (primary data) and analyzing them by method of ranking and severity index, accident density method, weighted severity index. Locations appearing in all the three methods were termed as black spots. Further corrective measures were suggested.

Keywords: Transportation, Road traffic accidents, Accident Black Spots, National Highway.

I. INTRODUCTION

National highways form the economic backbone of the country and have often facilitated development along their routes. Nothing is more important to civilization than transportation and communication and apart from direct tyranny and oppression; nothing is more harmful to wellbeing of society than irrational transportation system. Every day, 3300 deaths and 6600 serious injuries occur on the road in the world. Road accidents and persons killed in India have been reported to the tune of 4, 90,383 and 1, 38,258 respectively during 2012. On National Highways (NHs), major share of accidents (about 29%) and number of persons killed (35.3%) are observed out of total accidents. Understanding the seriousness of issue, corrective measures are being taken all over the globe. In India National Road Safety Council (NRSC) is the apex body for road safety, requested all States/UTs in the year 2010 for setting up of State Road Safety Council and District Road Safety Committees and to hold their meetings regularly curb the menace of Road Accidents and give priority to road safety. For the identification of accident-prone spots an Accident Prevention Committee (APC) had been set up in the year 1997 by the Government of Maharashtra State. The committee had inspected 18027 kilometers of the rural highway and 7313 accident -prone spots were identified. Out of these identified spots, 5960 spots were improved. But even after the appointment of the committee and the corrective measures undertaken by them the number of accidents were increasing, the possible reason being shifting of accident black spots to new locations. Therefore more research on accident black spot identification is required and better methods need to be invented. This paper includes pilot study of identification of accident black spots on national highway 4 (New Katraj Tunnel to Chandani Chowk) by the method of ranking and severity index.

II. BRIEF OVERVIEW OF LITERATURE

Aruna.D.Thube & Dattatraya.T.Thube(2010): The objective of this paper was to study the rural highways and finding out various causes of accidents and also to suggest the remedial measures. The identification of the accident-prone areas was done by the PWD as per the data obtained from local police station. These locations were classified based on the severity of accidents. Further the type of remedial measure to be adopted at these location was mentioned. Snehal U Bobade, et al. (2015) hinted that accident-prone locations can be identified by ranking the parameters based on their severity and calculating the severity index. Physical survey was carried out at the actual location for selected stretches of Mumbai- Pune Expressway and Pune- Solapur Highway. The parameters which caused maximum number of accidents were assigned maximum weightage and top rank. The summation of the weightages were calculated to find out the total severity. The severity Index was then calculated by adding the weightages of each parameter present divided by the total severity. Srinivasan et al. (1987) observed that for identification of accident black spots on national highway in Kerala, there are three scientific methods which can be used namely Quantum of Accident Method; ii) Accident Prone Index (API) method and Weighted Severity Index (WSI)method and it was concluded that weighted severity index method was found to be most suitable. Dr. Wichuda

Kowtanapanich found out that both conventional method and public participation method were used to identify the black spot locations. The methods used for identification of black spots were Accident Rate Method, Accident Density Method, Severity Index Method, Number of Accidents Method, Quality Control Method and Combined Method. Nikhil.T.R(2013) used the concept in which the accidents were classified based on the severity of injuries.The accident data for Bangalore city was obtained from the Bangalore City Police and the total number of accidents for each year from the years 2002-2011 was found out. This accident data was compared with the Karnataka State data. The accident data from the Gorguntepalya and Jalahalli Traffic Police Station was analyzed. The classified volume count data i.e. the number of vehicles per day passing at different locations was found out. Remedial measures for selected spots were suggested.

III. RESEARCH METHODOLOGY

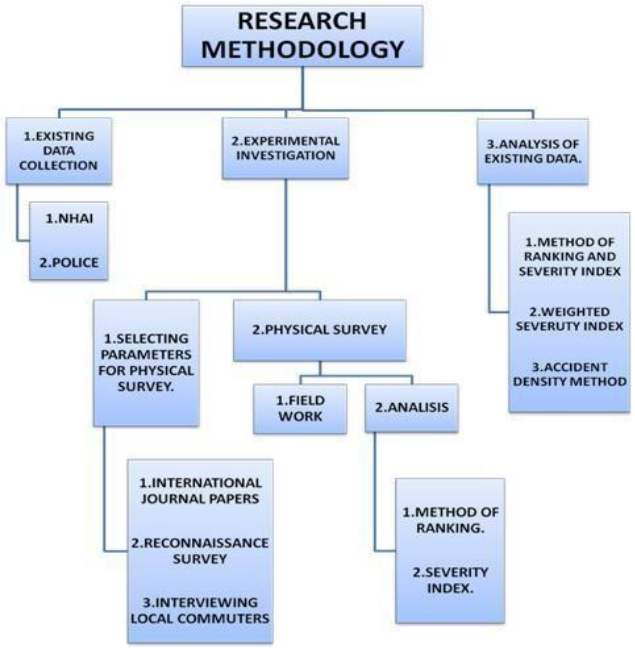


FIGURE 3.1 Flow chart of research methodology adopted

Methodology adopted mainly includes collection of existing data, experimental investigation and analysis of existing data.

Existing Data Collection: There are two methods to identify accident black spots. One is by conducting physical survey considering predominant causes of accidents and other is to analyze the existing accident data of a particular stretch. Methodology for this research includes identification of black spots by correlating the physical survey with existing accident data. Existing data was collected from following sources.
NHAI (National Highway Authority of India)
Police Station

Experimental Investigation:
1.Selecting Parameters for Ground Survey. There are many parameters that can cause accidents on national highways but only the parameters that are more predominant in the study area had to be selected. These factors were finalized on the basis of following factors (i)International Journal Papers (ii) Reconnaissance Survey (iii) Interviewing Local Commuters
2 .Ground Survey: Ground survey was carried out to find the severity index, (i)Field Work (ii)Analysis of ground survey further the analysis of ground survey was done by two methods (a)Method of Ranking (b)Severity Index.

Analysis of Existing Data
Existing data collected from NHAI and Police station was to be correlated with the data collected from physical survey to identify accident black spots. It was analyzed by following methods.

1. Method of Ranking and Severity Index
2. Accident Density Method
3. Weighted Severity Index

3.1 Existing Data Collection: In order to determine the accident prone locations in our area of interest, following data was collected and used.
3.1.1. Chainage wise accident data obtained from NHAI for NH4 along with the Nature of accident, Causes of accident, classification of accidents, Road features, whether condition.
3.1.2. Rough accident prone locations as suggested by the Police station.
3.2 Experimental Investigation
3.2.1 Selecting Parameters for Ground Survey: Following parameters were finalized based on international journal paper, reconnaissance survey & interviewing local commuters.

- Horizontal curve on downward slope.
- Amenities separated from their users.
- Small subsidiary road meeting highway (Y-Junction)
- Absence of guard stones or curve indicator on the curve
- Passenger pick up shades
- Roadside Vendors
- Downward slope followed by a horizontal curve
- Passenger pick up shades at junction
- Absence of roadside railing
- Wayside bus stop without bus bays

3.2.2 Physical Survey
1. Stretch of 14.6km was selected on NH4 from Chandani Chowk to New Katraj Tunnel.
2. Selected parameters were inspected at every 100m chainage.: The stretch is highly prone to accidents. Parameters causing accidents are present at short intervals and therefore to achieve high degree of accuracy, chainage as small as 100m was selected.
3.2.3 Analysis of Data Collected in Physical Survey: Method adopted for analysis is called as Method of ranking. 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.

Method of ranking.

- For all the 10 parameters, the number of chainages denoting Y were calculated (Say α).
- 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.

Severity Index

Severity Index denotes vulnerability of a particular spot to accidents.

Severity (β) was calculated by adding Yrespectivefora particular chainage.

Severity Index (SI) was calculated as shown below;

SI = (β/ ΣW) x 100

Where, ΣW= w1+w +…+w

2 10

iii. Severity Index Benchmark:

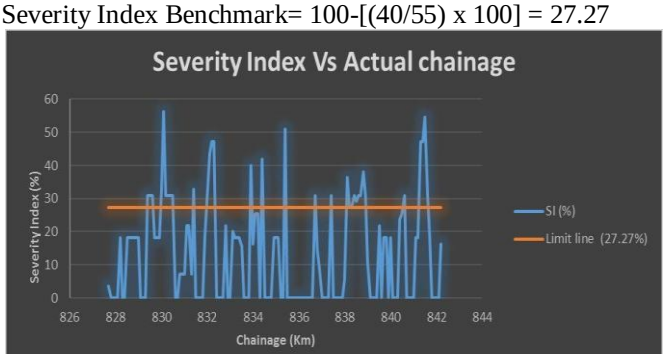
Severity index benchmark is the severity index value above which corresponding spots are black spots.

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 10+9+8+7+6= 40

Weight age of all parameters= 55

Severity Index Benchmark= 100-[(40/55) x 100] = 27.27



Graph 1: Above graph shows the relationship of Severity index and actual chainage. The blue line indicates severity index and the orange line indicates the limit for severity index. Severity index more than 27.27 is considered as very high.

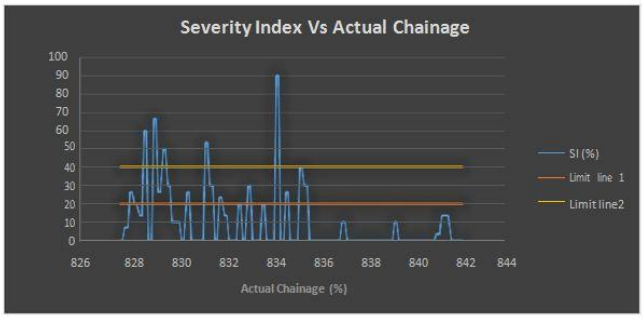
Analysis of Existing Data : Existing data collected from NHAI and Police station was to be correlated with the data collected from physical survey to identify accident black spots. It was analyzed by following methods.

Method of Ranking and Severity Index

The causes of accidents given in the existing data were,

- Overturning
- Head on collision
- Rear end collision
- Skidding
- Vehicle out of control

These 5 causes were chosen as parameters for method of ranking and severity index.



Graph 2 : Above graph shows the relationship between severity index and actual chainage. Blue line indicates the severity index. Orange and yellow lines are the limit lines. Severity index between the two limit lines is high and that beyond 40 is very high.

Accident Density Method

- 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.
- Unit length is taken as 500m.
- 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

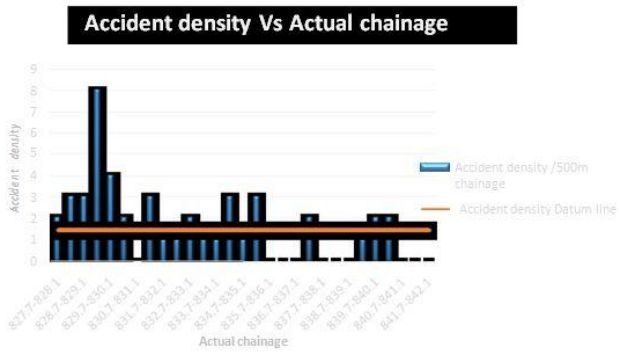
Per unit length

Sample calculation,

Average no. of accidents = (44) / (29) = 1.51

Per unit length

Every 500m length of the stretch where no. accidents is more than 1.51 is termed as accidental black spot.

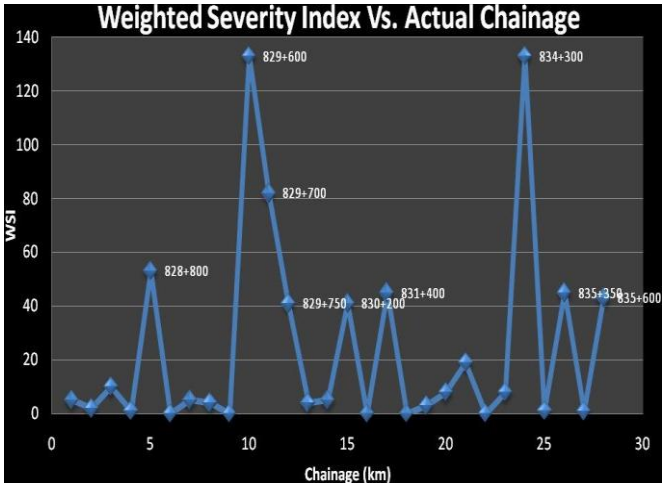


Graph 3: Above graph shows the comparison between accident densities at different chainages. X-axis shows the actual chainage whereas Y-axis shows accident density per 500m chainage. Orange line is the limit line. Accident density per 500m more than 1.51 is considered as very high.

Weighted Severity Index

- WSI follows a system of assigning scores based on the number and severity of accidents at that particular location.
- Severity of an accident is classified as Fatal (K), Grievous injuries (GI) and minor injuries (MI).
- WSI is calculated by formula, WSI = (41 x K) + (4 x GI) + (1 x MI)
- Locations having WSI more than or equal to 41 are termed as accident black spots.
- 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..



Graph 4 : Above graph shows the variation of WSI along the study area. WSI exceeding 40 is considered as very high and those chainages are written at respective points in above graph. (eg. 828+800 means 828.800km actual chainage.

IV. RESULTS AND DISCUSSIONS

Accident black spots were identified by correlating the data collected by the physical survey with existing data i.e. primary and secondary data. Existing data was analyzed by following three methods i.e. Method of Ranking, Accident Density Method and Weighted Severity Index Method. Table below shows the comparison of accidents by the three methods mentioned above. Investigation of the identified accident black spots was done and the locations as well as the causes of accidents was found out. The remedial measures implemented on the selected stretch of NH-4 were discussed. The corrective measures suggested for various identified black spots were providing speed limit boards, installation of cat eyes and road reflectors, providing road humps before the junction, improving sight distance at the junction by increasing set back distance at the junction, providing delineators and retro- reflective markers, curve indicators.

Sr.no	Actual chainage	Observations			
		Primary data	Secondary data		
		Physical survey SI (%) limit= 27.27%	Existing data analysis SI (%) Limits= 20% to 40% =Above 40%	AD method AD limit = 1.5	WSI method WSI Limit = 40
1	829.4	30.9	26.67	8	
2	829.5	30.9	50	8	
3	829.6	30.9	50	8	133
4	830.5	30.9	26.67	2	41
5	831.4	58.18	53.33	3	45
6	832	32.72	23.33	2	
7	834.4	41.82	90	3	131
8	835.4	50.9	40	3	45

Note : SI is % severity index at a particular chainage.AD = accident density, WSI = weighted severity index

4.1 Further scope of work:

The identified accident black spots can be thoroughly studied with respect to degree of slope, degree of horizontal curve, super-elevation and corrected if necessary. After rectifying the identified accident black spots of the study area if the frequency of accidents reduces then the method of ranking and severity index can be used to identify accident black spots on all types of roads such as Expressways, National highways, State highways, Rural highways, Major district roads, Other district roads etc.

V. CONCLUSION

The parameters causing accidents were selected by referring international journal papers, preliminary survey, interviewing local commuters. The analysis of Field survey data (primary) and existing data (secondary) was done by method of ranking and severity index .The secondary data was further analyzed by Accident Density Method and Weighted Severity Index and was correlated with the results obtained from above methods to suggest remedial measures for the identified black spots by revisiting them and finding out the possible causes of accidents.

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