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Recognition of Accidental Black Spots from New Katraj Tunnel to Sarola

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ABSTRACT: In this text, a literature review is given of the method and techniques that are used to analyse black spot and black zones. Although, no universally accepted definition of a black spot or black zone is given, these locations will in general be described as high risk accident locations. In this context, several statistical models are described in literature to model the accident frequency and accident severity. This study gives an overview of these models. Additionally, several alternative methods that are used to identify and rank black spots are described. Furthermore, some techniques that are used before and after studies to estimate the effect of treatment on these sites are discussed in this text. Finally, an overview of the method and techniques that are used in Belgium, Denmark and Australia to analyse black spots is presented.

KEYWORDS: Black Spot Analysis, Accidental Point, Analysis Methods, Relative Rating, Weightage, chainage.

I INTRODUCTION

The national highways network of India is responsible for the development of civilizations and economic development of the country by meeting the travel requirements of people and goods. Road accidents are one of the major elements which block the development of civilizations and economic growth due to the high economic loss as well as loss of life it causes. Hence it is important to identify such places of high accident chances and rectify them as soon as possible. Several methods can be adapted to identify such accident-prone zones or accidental black spots. Accidental black spots are the spots where accidents have occurred historically many times. The government of India formulated the Accidental Prevention Committee (APC) in the year 1997 by identifying accidental prone spots on the rural highways of the state and suggested the suitable remedial measures for reducing the accidents (1). The present study aims to identify accidental black spots on a section (798 km-828 km) of National Highway - 4 by studying the accidental data provided by the National Highway Authority of India (NHAI) during the year 2017-2018. In the present study for identification of black spots, Severity Index Method and Accident Density Method is used. During that study, basic causes of accidents were found out and suitable remedial measures are planned to be provided for a particular spot.

II. RELATED WORK

This study aims at analyzing the problems present on selected spans causing accidents and to find remedial measures which will help to reduce accidents in future so there will be lesser deaths on that span occurring due to accidents and which will result in an increase in safety of traffic movement. This study includes spans starting from New Katraj Tunnel to Sarola Village which is part of NH-4 (Pune-Satara Highway) having chainage starting from 798 km to 828 km for accident analysis.

National Status

Gourav Goelet. al. (2016) Study deals with the characteristics and trend of road accidents on a selected stretch of NH-1 between RD 98 km and 148 km. Four-year road accident data from 2007 to 2010 of 50 km long stretch was collected which includes the period when construction of the 6-lane project started on NH-1 [1]. Sanjay Kumar Singh al. (2016)



aim of this paper is to analyse the road accidents in India at the national, state, and metropolitan city level. The analysis shows that the distribution of road accidental deaths and injuries in India varies according to age, gender, month and time. Age group 30-59 years is the most vulnerable population group, though males face a higher level of fatalities and injuries than their female counterparts [2]. MaenGhadiaet. al. (2016) Identification of road sections characterized by high-risk accidents is the first step for any successful road safety management process, considering the limited available resources. Although researchers started to study black spot decades ago, there are many un-clarified questions in this field. In the identification process of black spots, three main methods can be used: screening methods, clustering methods, and crash prediction methods[3]. 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. The physical survey was carried out at the actual location for selected stretches of Mumbai- Pune Expressway and Pune- Solapur Highway[4]. R.R. Sorateet. al. (2015) identified the accident black spots on National Highway-4 spanning 14.5Kms from New Katraj Tunnel to Chandani Chowk and to suggested remedial measures [5]. Prof. Jessy Paul et. Al. (2017) this study aims to find the major accident black spots in Kothamangalam and to identify various traffic parameters and road factors causing accidents. The capability of GIS to link attributes data with spatial data facilitates prioritization of accident occurrence on roads[6]. M Mohammed Fayazet. Al. (2015) This paper aims to identify the accident- prone zones within Cochin City, using Accident Severity Index Method and to locate the hotspots using Arc GIS software 9 [7]. K. Chandrasekhar Reddy et. Al. (2017) This study mainly deals with the identification of black spots (high-risk accident locations accident-prone locations) on Puttur to Ramagiri major road and suggesting its preventive measures [8]. Aruna Thube (2010) This paper discussed various causes for accidents found in the study and details of countermeasures as suggested by Accident Prevention Committee, and how improvement in black spots had been effective in reducing the number of accidents in the state [9].

International Status

Zhanyong Fan et.al (2019) developed machine learning method to identify black spot in urban road traffic. The study focuses on a fusion analysis of the multi-source influencing factors involved in traffic accident black spot. According to the structured association characteristics of urban traffic accident big data, a support vector machine method based on maximizing the classification interval is used to train the complex model and optimal learning of accident black spots in the study area [10]. Yetis Sazi Murat et.al (2016) stated that systematic approach is employed. Firstly, the traffic accidents data of Denizli city have been analyzed using the fuzzy clustering methods. The spots that are densely located around the cluster centers are determined as “black spots”. Secondly, the safety levels of black spots’ are determined by Shannon Entropy Approach considering accident types and effective factors on accident occurrence. Geometrical and physical conditions, traffic volumes, average speeds and average accident rates at around black spots are considered as effective factors on occurrence of accidents [11]. Rune Elvik (1996) stated that the more confounding factors evaluation studies account for, the smaller becomes the accident reduction attributed to black spot treatment. Studies that account for both regression-to-the-mean and a possible accident migration to neighbouring untreated sites do not show any net accident [12].

III. METHODOLOGY

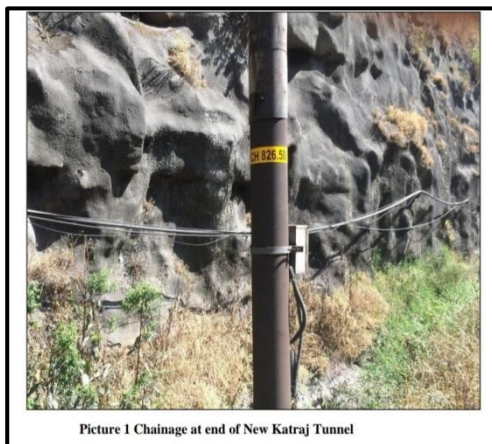
DATA COLLECTION:

Accident data has been collected for National Highway 4 from National Highway Authority of India. Data is collected for the following route: Accident data received from NHAI consist of following details like

1. Date of Accident
2. Time of Accident
3. Accident Location
4. Side of Accident
5. Nature of Accident a. overturning b. Head-on-collision c. Rear-end collision d. Collision brush e. Right turn collision f. Skidding g. Left turn collision
6. Classification of Accident According to Severity
 - a. Fatal
 - b. Greivous
 - c. Minor
 - d. Non-injured
7. Cause of Accident

- a. Drunken driver
- b. Overspeeding
- c. Vehicle out of control
- d. Fault of driver
- e. Fault of vehicle
- f. Fault of passenger
- g. Fault of pedestrian
- h. Defect in vehicle
- i. Road condition

1. Reconnaissance Survey: After reconnaissance survey, following observations were made 1. Most critical span on NH 48 was found out by observations, discussions with local residents, frequent road users and road side shop owners.
2. Chainages of starting point of selected span was found out by this survey which is shown in following picture
3. Safety of this road needs to be improved as accidents numbers are increasing day by day.
4. Traffic conditions vary from time to time, usually traffic is higher in morning and evening while in afternoon traffic is less. Traffic is at peak in weekends due as this road connects many tourist spots and religious places.
5. Ongoing road constructions affect road safety, as road width has considerably reduced due to ongoing constructions of bridges and flyovers. Traffic accumulation is high results in accidents.
6. Crossing points, divider ends are the most accident-prone spots.
7. Cable barriers are provided on some curves and near Katraj tunnel ends. Grouting is provided for stabilizing mountains surrounding roads. Ambulance service is very good and in time.
8. Average speed of traffic is considerably good but accident reduces traffic movement in peak hours and weekends.
9. Roads are poorly maintained due to ongoing construction activities. This can be shown as in following picture.



Picture 1 Chainage at end of New Katraj Tunnel



Picture 2 Present road conditions at NH 4

10. Major cause of accident is over speeding of vehicles.
11. Major nature of accident is rear end collision of vehicles.
12. Afternoon to evening is the most critical time of accidents.

IV. EXPERIMENTAL RESULTS

IDENTIFICATION OF BLACK SPOTS:

1. Accident Density Method: In this method data is separately analysed for every 500 m span and then the graph of chainage on X-axis and no of accidents on Y-axis is plotted from that graph point where maximum no of accidents occur are found out.

2. Severity Index Method: To identify various traffic and road related factors causing accidents. The reading was taken on Pune-Solapur National Highway then analysed by the method of ranking by considering all parameters of the most important parameter because of which more number of accidents occurs had given top rank and maximum weight. Severity index is calculated on the basis of two points as follows

ANALYSIS:

Detailed analysis of data obtained from the National Highway Authority of India (NHAI) using various methods and Microsoft Excel. Methods used in the analysis

I. Accident Density Method: On this basis, the total accident hazard is expressed as the number of accidents of all types per km of each highway and street classification. $R = A/L$ Where, R = total accident rate per unit length for one year A = total number of an accident occurring in one year L = length of control section in kms from this method, we get areas having most no of accidents in the entire span

II. Severity Index Method: This method involves finding total no of accidents occurred due to various causes and then ranking them according to their severity, then accidents are ranked according to their frequency of occurrence in order of highest to lowest number then cause due to which highest no of accidents occur are given least weight and cause due to which lowest no of accidents occur are given most weight accordingly, Then severity index is found out for each cause by the following formula Severity Index = $(W_f / \sum W_{all}) \times 100$ Where, W = weight of that particular $\sum W_{all}$ = sum of weights of all factors By applying this formula, a graph of chainage vs severity index of that accident.

III. Severity Index Method: Severity index is found out for each cause by the following formula, Severity Index = $(W_f / \sum W_{all}) \times 100$ Where,

W = weight of that particular factor $\sum W_{all}$ = sum of weights of all factors By applying this formula, a graph of chainage vs severity index of that accident.

Following pie chart shows detailed analysis of each black spots according to their nature of accident, according to nature of accident and cause of accident.

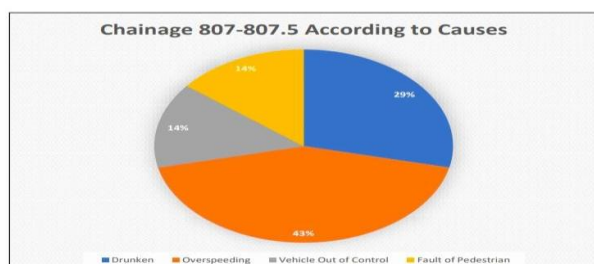


Figure 4: Pie chart showing distribution of accident causes at 807-807.5 km

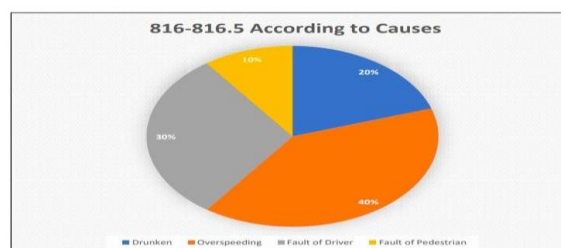


Figure 6: Pie chart showing distribution of accident causes at 816-816.5 km

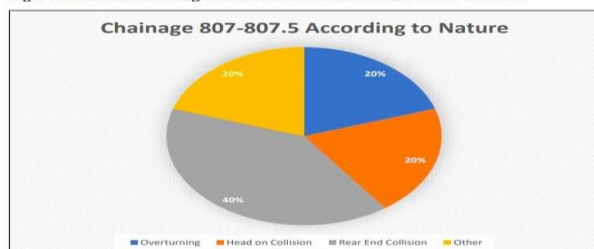


Figure 5: Pie chart showing distribution of accident natures at 807-807.5 km

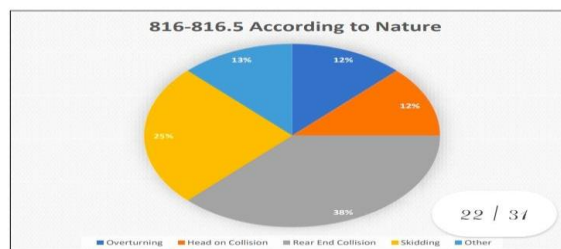


Figure 7: Pie chart showing distribution of accident natures at 816-816.5 km

4. Analytical Hierarchy Process When calculations were done using Analytical Hierarchy Process using the following formulas

Weightage = $(\text{Rating for each parameter} \times \text{Relative Rating}) / 100$

Weightage (Average) = $(\sum \text{All Weightages}) / (\text{No of Experts})$

Fractional Weightage = $(\text{No of accidents at that chainage due to a sub parameter}) / (\text{Sum of all accidents at that chainage due to a sub parameter})$

Individual AHP Score for a Sub parameter at a chainage = $(\text{Fractional Weightage}) / (\text{Average of Weightages})$

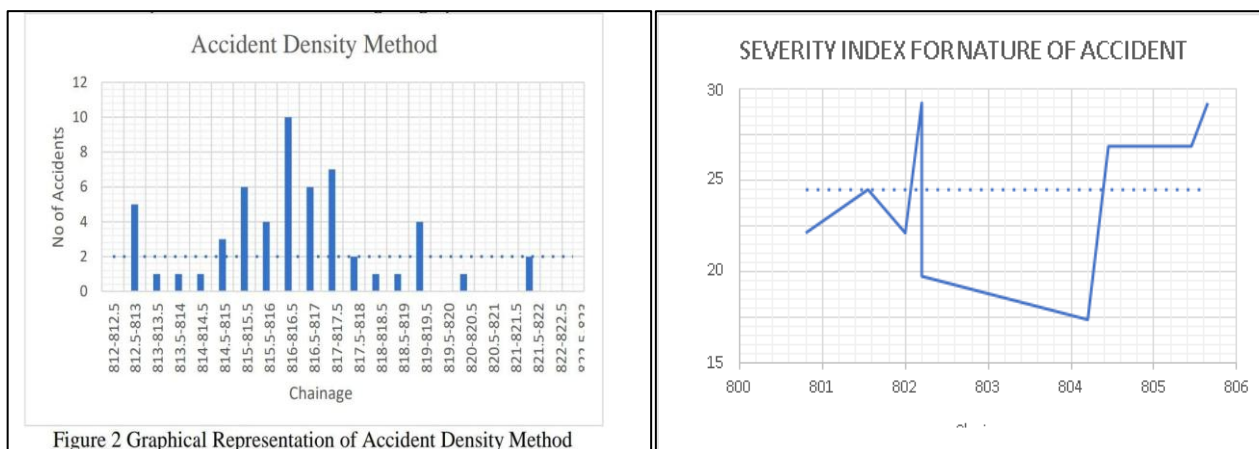


Figure 2 Graphical Representation of Accident Density Method

The graph represents number of accidents at different chainages by accident density method. The second graph represents nature of accidents by severity index method.

V.CONCLUSION

This study was an attempt to finding, analysing and providing remedial measures for accidental black spots on National Highway 48 from New Katraj Tunnel to Sarola Village (Chainage 797 km- 827 km). Reconnaissance survey carried out concludes that this span is the most critical span on NH48 and actions were needed to be taken. Various accident spots were located by analysis of data out of which there most severe spots were taken into account for further study. Black spot analysis by Analytical Hierarchy Process highlights dominant accident-causing factors namely over speeding of vehicles, Rear end of vehicles, skidding of vehicles; also, it was found that most of the accidents were occurred

VI.ACKNOWLEDGEMENT

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