Identification Of Accident Black Spots For National Highway Using GIS

Apparao. G, P. Mallikarjunareddy Dr. SSSV Gopala Raju

Abstract: - In some countries where the economies are weak, it becomes crucial for those concerned with developmental policies to adopt approaches which will ensure that every single cent available is used to develop the country. In those fields to facilitate a conductive environment for economic development. Road traffic accidents have been recognized as one of those adverse elements which contribute to the suffocation of economic growth in the developing countries, due to the high cost related to them, hence causing social and economic concern. So Traffic safety is an important key and integral role in sustainable transportation development areas. Now days, the main negative impact of modern road transportation systems are injuries and deaths in road accidents. The success of traffic safety and highway improvement programs hinges on the analysis of accurate and reliable traffic accident data. This study discuses the present state of traffic accident information on NH-58 from Meerut to Muzaffarnagar in Uttarakhand State. It shall also discuss the Identification of high rate accident Locations by using GIS Software and safety deficient areas on the highway. So, implement the remedial measures to those accidental locations (Black Spots) and provisions for traffic safety.

1. Introduction

Worldwide, the transportation problems faced by various nations have increased manifold, necessitating search for methods or alternatives that ensure efficient, safe, feasible and faster means of transport. It has been estimated that India currently accounts for nearly 10% of road accident fatalities worldwide. In addition, over 1.3 million people are seriously injured on the Indian roads every year. Hence, traffic safety has become a major area of concern for the authorities. The development of urban transport system has not kept pace with the traffic demand both in terms of quality and quantity. As a result the use of personalized transport mainly two wheelers and intermediate public transport is growing at a rapid speed. The disproportionate Growth in the traffic vis-a -vis growth in road length along with unauthorized encroachments on road space, lack of traffic and lane discipline and deficiencies in traffic control have contributed to the increasing problem of congestion in urban areas. The advancements in GIS and GPS can be put to effective use in accident analysis. Although GIS has been used for over thirty years however it has only been recently used in the field of Transportation. In addition to promoting linkage between various types of data and maps GIS is able to manipulate and visually display numerous types of data for easy comprehension. GIS is a technology for managing and processing location and related information. It visually displays the results of analyses thus enabling sophisticated analysis and quick decision making. Development of a system that uses GIS to analyze traffic accidents has been pursued towards improving the efficiency and effectiveness of traffic accident countermeasures. Also GIS would make analysis less time consuming and less tedious which otherwise would become very labour sensitive. Thus GIS will offer a platform to maintain and update accident record database and use it for further analysis.

- Apparao. G, P. Mallikarjunareddy, Dr. SSSV Gopala Raju
- 1-Asst. Prof. in GITAM University, 2- Engineer at IVRCL Infra, 3-Professor, GITAM University
  Apparaog.iitg@gmail.com
  mallikarjunareddy207@gmail.com
  sssvgopalaraju@gmail.com

2. Study Area

Meerut and Muzaffarnagar are the Districts in the states of Uttara Pradesh and Uttarakhand respectively, India. The town of Muzaffarnagar is the district headquarters, and gives the district its name. Muzaffarnagar District is bounded by Meerut District to the south and Haridwar District to the north. The development of Haridwar and Rishikesh as important tourist destinations in the international tourist map, expansion of new educational institutions at Roorkee and other industrial developments have resulted in increased traffic demand on the National Highway-58. The MahaKumbh and ArdhKumbh at Haridwar and other festivals attract unmanageable number of pilgrims and during these events there is traffic chaos. During the rainy season, devotees of Lord Shiva (Karwaria) collect water from Haridwar and walk down to Pura Mahadeo near Meerut and almost for a period of one month the Highway is hardly available for traffic. The study area NH-58(from Km 75-Km138), a stretch of 63 Km selected for implementing the methodology involved, lies between 29° 0’00”N to 30°5’00”N Latitude and 77° 30’00”E to 77° 45’00”E Longitude.

3. Methodology and Materials Used

3.1 Data Collection

In order to determine the accident prone locations in Muzzaffanagar district, following data were
Collected and used.

1. Police stations limit map obtained from the office of super indented of police, .
2. Accident reports for the years 2007, 2008, 2009, 2010 and 2011.
3. Survey of India topological map at a scale 1:1, 50,000.

3.2 Collection of Ground Control Points

The GCPs are collected with the help of the GPS. Here there are five GCPs collected. From the survey of India topo sheet at various road intersections

3.3 Data processing

The data processing involves the following three steps. The flow chart of the data processing is shown below figure

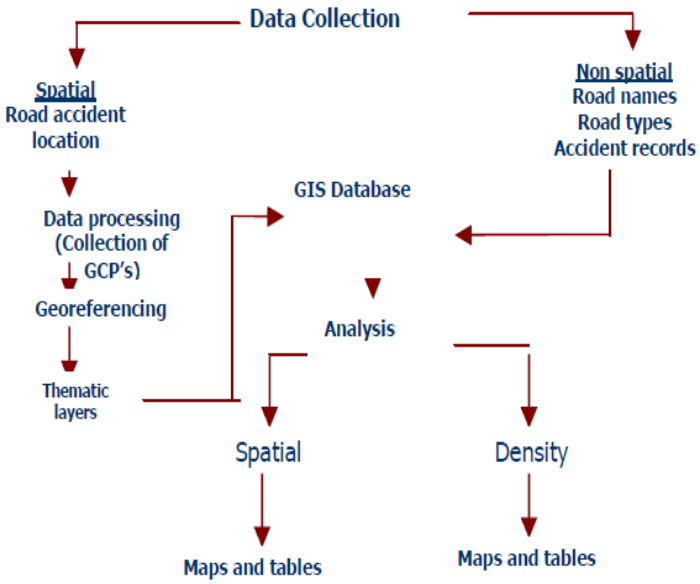

Figure1. Methodology

3.4 Map scanning

The Survey of India topographical map at a sale of 1:1, 50,000 were scanned as the raster input.

3.5 Geo referencing

Scanned maps usually do not contain information as to where the area represented on the map fits on the surface of the earth. To establish the relationship between an image co ordinate system and a map(x, y) coordinate system e need to align or geo reference the raster data.

3.6 Digitizing

Digitizing is the process of encoding the geographic features in digital form as x, y co ordinates. It was carried out to create spatial data from existing hard copy maps and documents. In the Present work the geo referenced raster image of Muzzaffanagar district is digitized using Arc GIS9.3. This type of digitization is called onscreen digitization. Road network of the study area was digitized as line features. Accident locations are digitized as point features. The above spatial data were organized in a personal geo database and feature class. The exact location of accidents was identified by using "measure" tool in ArcGIS9.3. By using the measure tool the spatial location of a particular accident can be marked by knowing its distance from a particular station. The map showing the accident locations for the years 2011 are shown in the fig 4.

3.7 Assigning attributes

All vector data (i.e. line, polygon, point features) will contain separate attribute tables. Here eachRoad is labeled with its corresponding name with the help of the city map obtained from thepolice station. Similarly the accident location attribute table contains the following data. These are shown in below figure 2

1. User identification Number
2. Police station limit
3. Month and date of occurrence
4. Time of occurrence
5. Exact area of occurrence
6. Type of accident
7. Type of injury
8. Type of vehicle involved

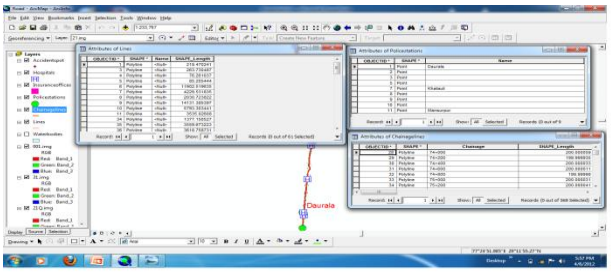

Figure2. Map Showing the Assigning of Attributes

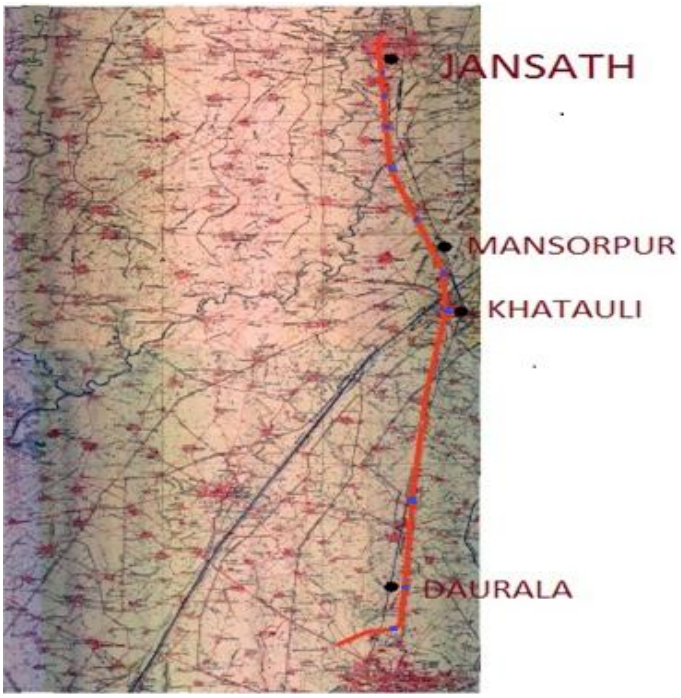

Figure3. Map showing the accident locations

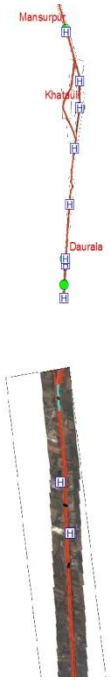

Figure4. Map showing the accident locations

3.8 Identification of Black Spot

A Location whether link or node that experiences abnormal Crash frequencies, rates is considered as an Accident Black Spot. The technique that is used the study to identify hazardous Locations is known as the Critical Crash Rate Factor Method. Since traffic crashes are random occurrences and can be considered as "Rare Events" it is not possible to identify hazardous locations simply on the basis of the number of crashes. Rather, the critical rate method incorporates the traffic volume to determine if the crash rate at a particular location is significantly higher than the average for the type of facility. If the crash rate of a particular location is significantly higher than the average crash rate for other locations in the jurisdiction having similar characteristics, the location is classified as an Accident Black Spot.

The steps involved in this method are as follows.

1. Determination of the location's crash rate: It is determined on the basis of exposure data, such as traffic volume and the length of road section being considered. Rate per 100 million vehicle kilometers (RMV) is the number of crashes per 100 million vehicle kilometers of travel. It is obtained from expression

$$RMV = \frac{Ax100{,}000{,}000}{VT}$$

A= No: of crashes, total at the study location during a given Period.

VT= vehicle kilometers of travel during the given period.

= ADT x (No: of days in study period) x (No: of Years) x (length of road Segment)

2. Determining the critical crash rate: The Critical Crash Rate Factor method involves the following expression:

$$CR = AVR + \frac{0.5}{TB} + TF\sqrt{AVR/TB}$$

Where,

CR= Critical Crash Rate, per 100 million vehicle-Km

AVR= Average Crash Rate for the Facility type.

TF= Test factor, standard deviation at a given Confidence level

(TF= 1.96 for 95% confidence level)

Where,

ADT = Average Daily Traffic

3. Compare the location's crash rate to the critical crash rate. If the crash rate exceeds the critical crash rate, classify the location as an Accident Black Spot. Accident Black spots are identified by using the "Critical Crash rate factor method".

In the present study a location is classified as an Accident Black spot if the ratio of the Crash rate of the section to the Critical crash rate of the particular type of facility is greater than 1.5. Some of accident spots are shown in figure:4

4. Conclusions

From the present study, following conclusions have been drawn:

1. In the last five years (2007-20011), the Total Crashes have increased by three folds on NH58 (from Km 75 – Km 138).
2. The Critical Crash Rate Factor Method is an easy-to-use statistical test method, which is very effective in identifying Accident-prone stretches for Four Lane Highways.
3. From analysis, it is clear that maximum number of crashes occurs during the weekends; this may be due to the large number of tourists coming to Haridwar and Rishikesh.
4. From analysis it is evident that maximum number of crashes occurs in the months of August and December. This may be due to the onset of rainy season in august and due to the fog in the month of December.
5. The peak period for Crashes comes out to be between 14.00 - 16.00 hrs.
6. The Crash ratio developed for the sections can be used for prioritizing Safety Development program.

Remedial Measures

The following table indicates the remedial measures for some accident spot

Accident Black Spots on NH58 (From Km75-138)	Cause of Accident	Remedial Measures
Km 119 to 120	1. Traffic volume is high and mixed	1. Installation of warning and informative signs
	2. Very high hot speed	2."Safe speed limit" be imposed in the area
	3. Heavy cross movement of pedestrain	3. Redesigning of the intersection

REFERENCES

[1]. Gopala Raju SSSV., 2011, "Vehicular Growth and Its Management in Visakhapatnam City – Case Study", Indian Journal of Science and Technology, Vol. 4, No. 8 , pp 903 – 906.

[2]. Bairwa, H.R., 2002, "A Study On Accident Black Spots On National Highway", Unpublished ME Dissertation, Department of Civil Engineering, Indian Institute of Technology Roorkee.

[3]. Gopala Raju SSSV., 2007, "Assessment of Noise level due to vehicular traffic at Warangal city, India", International Journal of Environment and Pollution", Vol 30. No.1, pp.137-153

[4]. Bhuyan, P.K, 2002," Accidents Analysis on Two-Lane Roads", Unpublished Seminar Report, Department of Civil Engineering, Indian Institute of Technology Roorkee.

[5]. Garber, N.J., Hoel, L.A., 2002, "Traffic and Highway Engineering", Third Edition, Thomson Publishing Company, New York, pp.131-172.

[6]. Jain, S.S., Parida, M., Chauhan, M.P.S. and Landge, V.S., 2004, "Identification of Hazardous Locations on National Highways", International Conference on Transportation Systems Planning and Operation (TRANSPO 2004), Chennai.

[7]. Gopala Raju SSSV., 2012, "Identification of black spots and junction improvements in Visakhapatnam City", Indian Journal of Innovations and Development, Vol.1, No.6, pp.469-471.

[8]. Jain, S.S., Parida, M., Chauhan, M.P.S. and Landge, V.S., 2004, "Development of an Alternative Method for Identification of Hazardous Location", National Seminar on Strategies in Traffic Engineering and Management (STEM –04), Bangalore.

[9]. Nadaf, A.M., 1999, "Accident and Drivers", Indian Journal of Transport management, Vol-23, No-6, pp 361-369.

[10]. Sarin, S.M., 1998, "Road Traffic Safety in Indian Issues and Challenges Ahead", Indian Highways, Vol. 26, No.6., pp 26-38.

[11]. Singh, H.N., and Sharma, M., 2002, "Report on Road and Traffic Safety," COTE, IIT-Roorkee.

[12]. Sinha, R.P., 2001, "Anatomy of Accidents", Newsletter, The Indian Roads and Transport development Association (IRTDA), Vol.LXX, No.10.