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A GIS APPROACH FOR IDENTIFICATION OF ACCIDENT HOTSPOTS AND IMPROVEMENT AT INTERSECTIONS IN HYDERABAD CITY

MD KHAJA MOHIUDDIN[1], MIR IQBAL FAHEEM[2] AND MOHD. MINHAJUDDIN AQUIL[3]

[1]PG Scholar, [2]Professor & Head & Vice Principal, [3]Asst. Prof., Dept of Civil Engineering
Deccan College of Engineering & Technology,Aghapura, Hyderabad-500001 Telangana, India

Abstract

Accidents have been a major social problem in the developed countries of world for over fifty years. It is only in the past decade that developing countries like India have began to experience large increase in the number of road accidents taking place and have found it necessary to institute road safety programs. It is strongly felt that most of the accidents, being a multi factor event, are not merely due to drivers fault on account of driver's negligence or ignorance of traffic rules and regulations, but also due to many other related factors such as abrupt changes in road conditions, flow characteristics, road user's behavior, climatic conditions, visibility and absenceof traffic guidance, control and management devices. In this study, an effort has been made to identify the accident prone zones within Hyderabad district, Telangana using GIS. In the above context an attempt is made to study various types of accidents including causative factors and black spot identification in Cyberabad area. The study involves collection of accident data from various police stations for this purpose, the road accident data for the year 2016, pertaining to Cyberabad area has been used. Accident particulars like date, location, type of vehicle involved, number of persons injured or died are included in the GIS database. Accident analysis studies aim at the identification of high rate accident locations and safety deficient areas. Traffic safety is an important key and plays an integral role in sustainable transportation development. Now days, the main negative impacts of modern road transportation systems are injuries and deaths in road accidents. The road geometry was measured in the accident

prone locations to find out the causes for the accident. Based on the result, suggestions are provided to reduce the accidents in the future. The Analysis of accident data is done by using "IBM SPSS" software and graphical representation is shown in this research. Remedial measures and provisions for traffic safety are suggested for reducing the risk of accidents in black spots.

***Keywords*- Geographic Information System, Road Network, Accident hotspots, Accident prone locations, Intersection Improvement…etc.**

1. INTRODUCTION

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 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.Identification of hotspots is a systematic process of detecting road sections that suffer from an unacceptable high risk of crashes. These identified sites are often known by various terms in literature, such as hazardous locations, hotspots, black spots, priority investment locations, collision-prone locations, or dangerous sites.GIS allows highway departments to accurately capture and analyze traffic accident information as well as identify dangerous highway segment locations with high accident rates. GIS, combined with complex statistical analysis and business intelligence tools, helps highway engineers better understand the causes of accidents at these locations and find ways of reducing them.The main advantage of using GIS is its ability to access and analyze spatially distributed data with respect to its actual spatial location overlaid on a base map of the area of coverage that allows analysis not possible with the other database management systems. The main benefit of using the GIS is not merely the user-friendly visual access and display, but also the spatial analysis capability and the applicability to apply standard GIS functionalities such as thematic mapping, charting, network-level analysis, simultaneous access to several layers of data and the overlayment of same, as well

as the ability to interface with external programs and software for decision support, data management, and user-specific functions.Many factors may exhibit a measurable influence on driving behavior and traffic safety. These include, but are not limited to: 1) Human factors such as improper judgement of road ahead and traffic, driving under the influence of alcohol or drugs, driver education and experience, young driver, age and sex. 2) Traffic factors like speed, volume, density, capacity, traffic mix and variation. 3) Vehicle deficiencies, such as defective brake, headlight, tyres, steering and vehicle condition. 4) Road condition like slippery or skidding road surface, ravels, potholes, ruts, etc. 5) Road design such as inadequate sight distances, shoulder width, no of lanes, improper curve design, improper lighting and traffic control devices. 6) Weather condition like fog, heavy rainfall, dust, snow, etc. 7) Other causes such as enforcement, incorrect sign and signals, service station, badly located advertisement, stray animals, etc.

2. LITERATURE REVIEW

Yakar, 2015, Accident analysis statistical methods (accident frequency, accident rate, severity index, quality control and combined method) were used to identify hazardous road locations on the highways in Turkey. Kumar and Rao (2014), have made a case study on Vishakhapatnam city, according to them road accidents in the present era are contributing to major deaths due to increase in vehicular density. It has been predictable that over 3lakhs persons die and 1.5lakhs persons are injured every single year in road accidents all over the world. Apparao et al., 2013, Accident analysis statistical methods (accident frequency, accident rate, severity index, quality control and combined method) were used to identify hazardous road locations on the highways in Thailand. Reshma and Sheikh (2012), in their study prioritized some of the major accident spots generally referred to as black spots in South Bangalore by using Arc GIS software by assigning possible weights for various accident components. Rodzi et al.(2011),According to Ahmad, it has been a big concern for many people and government to reduce the amount of road accident specially in Malaysia since it could be a big threat to this country The lack of a comprehensive accident recording and analysis system in Malaysia can be effective in these kinds of problems. By making use of IRAS (Intelligent Road Accident System), the police would be control and manage whole accident events as a real-time monitoring system.

3. STUDY AREA

Hyderabad, a 400 year old city is the state capital of Telangana. It lies on the Deccan Plateau, 541 meters (1776ft) above sea level, over an area of 625 sq.km of municipal corporation and 7200sq.km of Hyderabad Metropolitan area, is the fifth largest city in India, with apopulation of above 8 million. Unlike other Indian metros it continues to attract considerable migrant population due to its strategic geographical location, multilingual and cosmopolitan culture, tremendous growth potential and investment friendly economic policy has propelled the overall population growth of the city and the surrounding areas.Hyderabad along with the surrounding ten Municipalities constitutes the Hyderabad Urban Development Area (HUDA) and has been growing at an average rate of 9%.Population with an estimation to touch 13.64 million by 2021, and the increase in vehicular number has definitely created crisis in Hyderabad. The increase in the vehicles since last 10 years has put lot of pressure on the existing roads and ultimately resulting in road accidents. It is estimated that since 2001 there is an increase of 202 percent of two wheeler and 286 percent of four wheeler vehicles with no road expansion. Cyberabad consists of all the outskirts and semi urban areas of the Hyderabad. Areas such as Madhapur, Kondapur,Gachibowli, Uppal, Medchal and Shamshabad etc. come under Cyberabad. Cyberabad surrounds Hyderabad on allsides.

In other words, the area around the Hyderabad that has been developing lately is called as Cyberabad. Withthe aggressive promotion of some areas of Cyberabad, there have been extensive investments in luxuriousresidential townships, technological infrastructure such as Hi-tech city and many other IT and ITES companies. Areaand Population of Cyberabad is approximately 3600 sq.km and 80 lakh, study area of Hyderabad can be seen in.The main reason for road accidents in the city of Hyderabad is attributed to physical characteristics. The study tries to assess the increase in vehicular number and its effect on road accidents, also tries to locate the hotspots of road accidents and its causes.

4. METHODOLOGY

The overview of the methodology for system development can be seen the Figure 1 below, and a brief description of each phase will follow. In this paper police accidents data of 2016

was collected from Cyberabad Police officers. Also the identification of accident hot spots has been done after data collection.

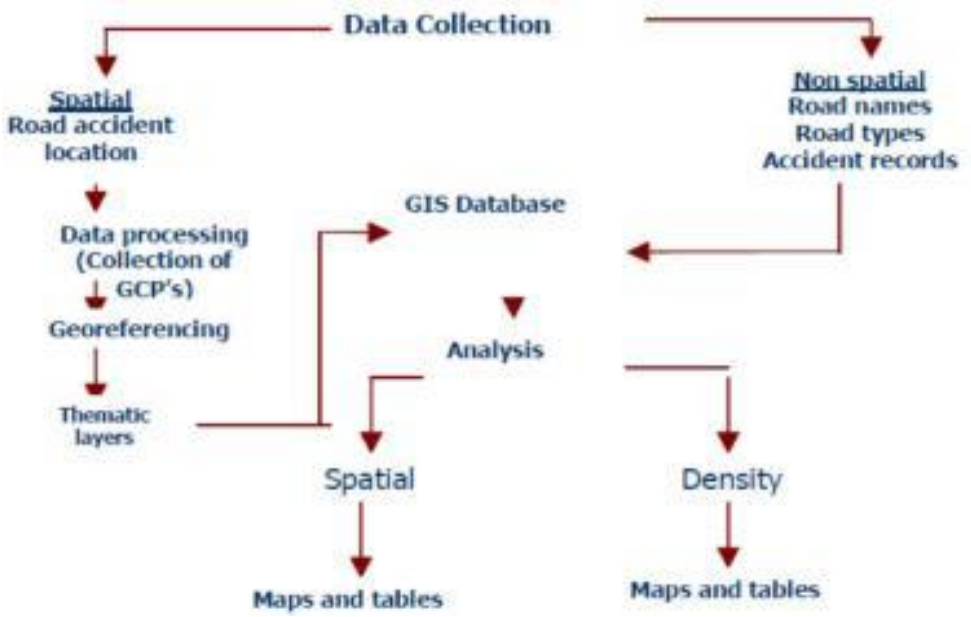


Figure 1 Research process

Data Collection: Accident data of different types were compiled from the records and files at office of the Traffic Police Department, Cyberabad. Data collection is of two types i.e. Spatial and Non Spatial. The spatial data provides exact geometric information such as location, boundary extend and road network. The available information about spatial data is called non-spatial data. The accident details include date of accident, Time, Type of Accidents, Type of injury, Time of occurrence, Vehicles involved, Gender, Month and date of occurrence of accidents, Licensed or Non Licensed, Drunk and drive etc. These details were collected from commissionarate of police, Cyberabad as presented in Figure 2.

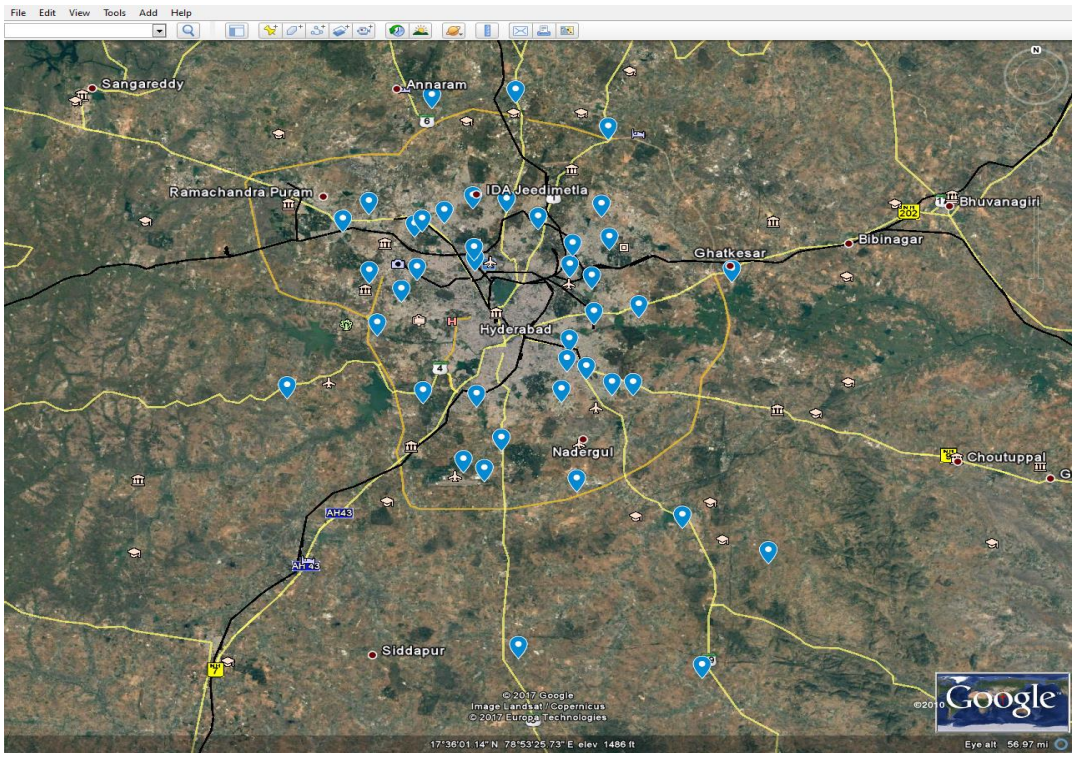


Figure 2 Accident locations

Data Processing: The accident spot locations are converted into shape files using ArcGIS software which is presented in Figure 3. The accident details were added as attribute data. Layering the image in ARC GIS and then traced on it using polyline in another layer after that image layer is closed and a layered map of Hyderabad is obtained.The crash locations are presented by only a point symbol along the digitized map. In fact, the symbols coincide and the concentration of crashes which have occurred more than once cannot be conveyed precisely.

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

***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. 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 geodatabse and feature class. The exact locations of accidents were identified by using "measure" tool in ArcGIS10.

***Assigning attributes*:** All vector data (i.e. line, polygon, point features) will contain separate attribute tables. Here each road 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 data such as, 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, etc.

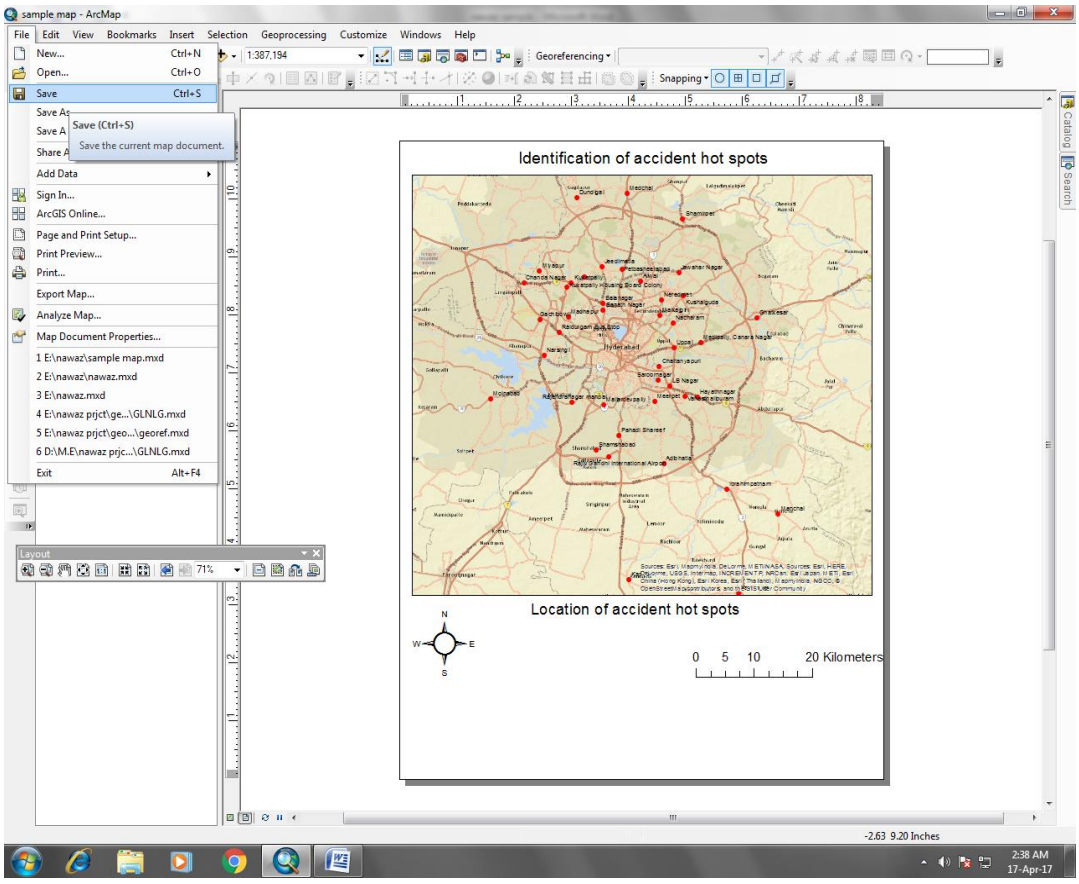


Figure3 Screen shot of Map generated in ArcGIS

5. ANALYSIS OF ACCIDENT DATA USING SPSS SOFTWARE

Accident data pertaining to Cyberabad were collected from the authorized sources for a period of 1year is presented in Table 1. From the data collected for all the road length varies significantly. It is very difficult to conduct any national or state wise road safety analysis, as the data available do not permit any scientific analysis of road traffic rashes and the associated risk factors.

Table 1 Accident Cases

ACCIDENT ANALYSIS FATALITIES - GENDER AND AGE GROUP BASED ON THE NO. OF DEATH IN FATAL ACCIDENTS REPORTED								
S.No.	**Month**	**Gender**		**Age group**				
		Male	**Female**	**0 -10 yrs**	**10-20 yrs.,**	**20-30 yrs**	**30-40 yrs.,**	**40 yrs., above**
1	January	45	10	7	8	18	17	5
2	February	56	9	6	23	22	8	6
3	March	71	5	2	15	28	14	17
4	April	68	12	5	31	19	11	14
5	May	76	7	11	26	23	13	10
6	June	62	10	7	22	17	14	12
7	July	71	8	1	20	18	18	22
8	August	60	12	0	21	19	16	16
9	September	58	10	3	19	18	10	18
10	October	57	3	1	11	19	9	20
11	November	53	13	3	3	24	16	20
12	December	59	10	3	2	4	31	29
Total		**736**	**109**	**49**	**201**	**229**	**177**	**189**

The collected accident report data is analyzed in SPSS software and the graphical representation of the data is obtained from SPSS as shown below in Figure 4to 7 representing involving various accident cases.

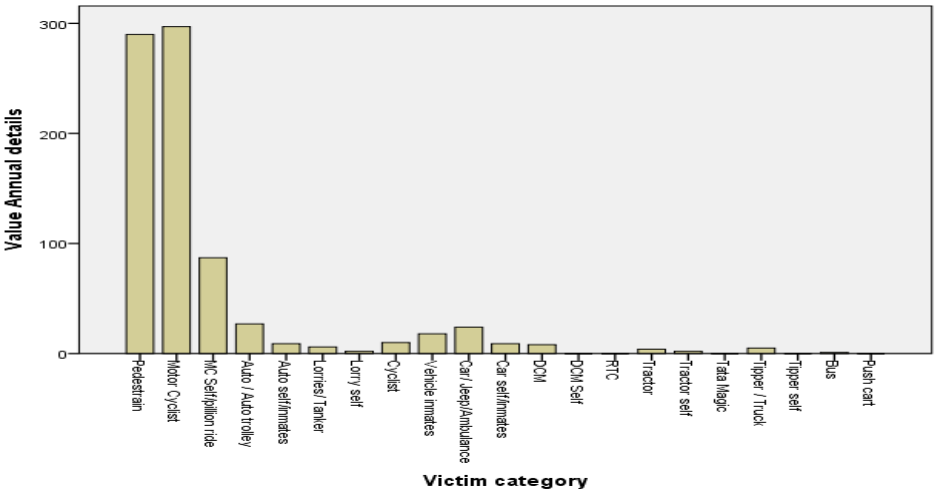


Figure 4 Accident case involving victim vehicle

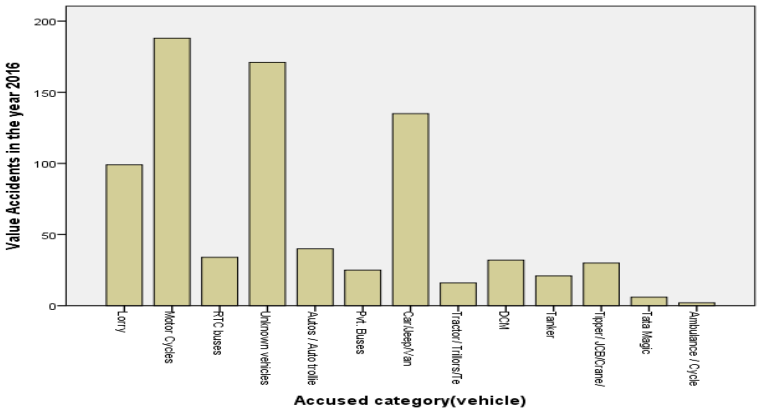


Figure 5 Accident case involving accused vehicle

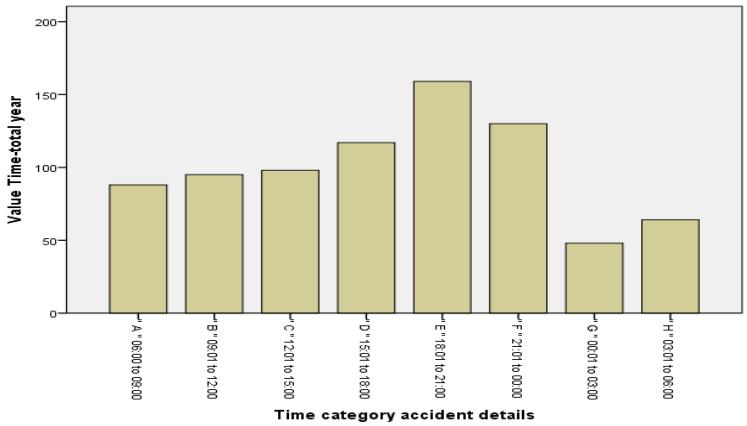


Figure 6Time wise accident cases

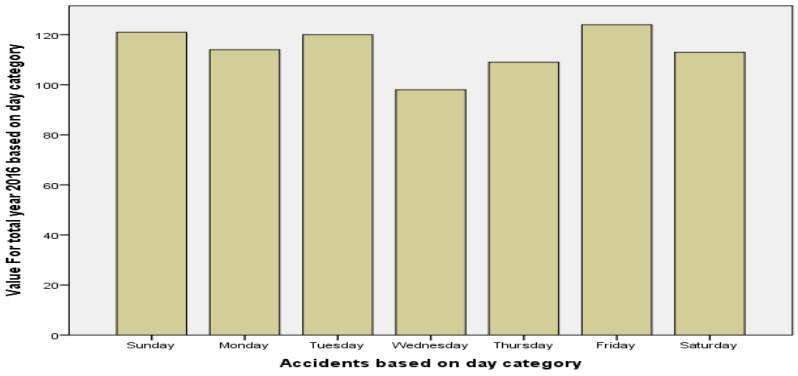


Figure 7 Day wise accident cases

CONCLUSIONS

The study was an attempt to find out the most vulnerable accident locations or the black spots inHyderabad district making use of GIS.The crux of the problem of urban transport is congestion of traffic. Widening of roads is not possible due to the intense developments on either side of the road.Heterogeneity of traffic is another problem which causes severe congestion. This work gives an insight into the present scenario of the traffic condition of the area and shows out the most accident prone roads in the district.It can also facilitate spatial data sharing within transportation agencies and between transportation department and other government agencies. This geodatabase in turn can be fed into "expert" systems and so provide accurate recommendations to vehicle drivers the police, motoring organization and of course local authorities. All relevant organization and authorities have been attempted to reduce the number of accidents and mitigate the severity of those accidents in several ways. In order to reduce these serious situations, the first afford is we need to identify the locations of the accidental occurrence areas. From the present study, following suggestions have been given for improvement:

- Provide footpath on both the sides of the road for the safety of pedestrians.
- Provide adequate drainages.
- Provide separate bus bays for avoiding delay of other vehicles at the bus stops.
- Take suitable enforcement measures to reduce the speed of vehicles.

- Remove or repair potholes for the safety of road users.
- Some sign boards are hidden due to trees, make it visible to the drivers.
- Provide necessary sign boards at T – junctions.
- Remove the illegal constructions from the road.
- Provide necessary road signs and markings.

The signals should be monitored in night time to control the night traffic. The movement of vehicles with high speed during night time is another cause of accidents.

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