CHAPTER - I
INTRODUCTION

1.1. ROAD TRANSPORTATION

Transport is vital for almost every aspect of economic, cultural and social growth. Road transport segment plays a very important role in the growth of any country mainly for developing nations like India. The surface transport system is important for the movement of passengers and goods and road transport is the backbone of the Indian economy. Roads are always considered as one of the basic components of infrastructure as it plays a decisive role in initiating and accelerating the process of development. Connectivity in terms of roads is considered as an indicator of development.

Indian road network of 33 lakh kilometers is second largest in the world and consists of Expressways (200 kms), National Highways (96,260.72 kms), State Highways (1,31,899 kms) Major District Roads (4,67,763 kms), Rural and Other Roads (26,50,000), Total Length 33 Lakhs Kms. About 65% of freight and 80% passenger traffic is carried by the roads. National Highways constitute only about 1.7% of the road network but carry about 40% of the total road traffic. Number of vehicles has been growing at an average pace of 10.16% per annum over the last five years. (NHA, 2016)

1.2. ROAD DENSITY

The density of roads is usually expressed as road length per one thousand square kilometres area. The roads carry nearly 85% of the passengers and 70% of goods of transport in the state of Karnataka. The state of Karnataka has a road density of 796 per 1000 square kilometre area which is slightly above the national average. (Government of India, 2016)

Development of roads is not only governed by plans and investment but also influenced by geographical factors such as relief, distribution of settlements, climate etc. The road network, though it is a physical infrastructure, largely determines diffusion of socio-economic facilities in the region. The average road length per 100
square kilometre area in the state is 40.07 kilometres. (only national highway, state highway and major district roads). In recent years the length of state highway has decreased due to their upgradation into national highway.

1.3. CLASSIFICATION OF ROADS

The road network of Karnataka comprises of national highways, state highways, district roads, village and municipal roads. There are several schemes and programmes of road development initiated by both central and state governments under which different categories of roads are constructed and maintained in the state. The government of India has recently proposed the “road development plan for India 2001-21”. In this plan, it has introduced the concept of primary, secondary tertiary roads replacing the earlier classification. The primary roads include express and Nation Highways, secondary roads including state and district roads. The tertiary road consists of other district roads and village roads.

The road network system in the old Mysore state was very good even in the pre-independence period. Roads were classified as state fund roads and district fund roads for the purpose of construction and maintenance. In contrast, till 1943, there was no systematic classification of roads in other parts of the country. Later according to the Nagpur plan in 1943, the roads were classified into National Highways, State Highways, District Roads, other District Roads and village roads. The integrated state had 43,182 kilometre road length, of which 26,423 km was of Old Mysore and the share of Bombay-Karnataka and Hyderabad-Karnataka region was 11,260 and 2,478 km respectively.

1.3.1. National Highways

The main highways run through the length and breadth of the country connecting major ports, state capitals, large industrial and tourist centres, etc. National Highways in India are designated as NH followed by the highway number. Indian national highways are further classified based on the width of carriageway of the highway. As of March 2012, India had completed and placed in use the following newly built highways: 5,846 kilometres of its 4-lane Golden Quadrilateral highway, 6,310 kilometres of its 4-lane North–South and East–West Corridor highway, 353
kilometres of 4-lane port connectivity highways, 4,553 kilometres of 4-lane inter-
capital highways, 961 kilometres of 4-lane bypass and other national highways.

The above 17,700 kilometres of highways connect most of the major manufacturing
centers, commercial and cultural cities of India. The National Highways Authority of
India (NHAI) is the authority responsible for the development, maintenance and
management of National Highways entrusted to it. The NHAI is undertaking the
developmental activities under National Highways Development Project (NHDP) in 5
phases. The NHAI is also responsible for implementing other projects on National
Highways, primarily road connectivity to major ports in India.

As of June 2012, under Phase I, II, III and V of India's national effort has already
finished and put in use about 18,000 kilometres of 4/6 lane highways. The country is
in process of building an additional 33,441 kilometres of 4 to 6 lanes, international
quality highways throughout India. Of this target, about 13,700 kilometres of modern
highways were under implementation in June 2012, and about 18,000 kilometres of
highways have been identified for contract award. India road building rate has
accelerated in recent years and averaged about 11 kilometres per day in second half of
2011. The country targets to build 600 kilometres of modern roads every month
through 2014.

1.3.2. State Highways

State Governments have the authority and responsibility to build road networks and
state highways. Independent of the NHDP program, state governments have been
implementing a number of state highway projects since 2000. By 2010, state highway
projects worth $1.7 billion had been completed, and an additional $11.4 billion worth
of projects were under implementation. The State Highways provide linkages with the
National Highways, district headquarters, important towns, tourist centers and minor
ports and carry the traffic along major centers within the state. Their total length is
about 137,712 km.

1.3.3. Major District Roads

These are important roads within a district connecting areas of production with
markets and connecting these with each other or with the State Highways & National
Highways. It also connects Taluk headquarters and rural areas to District headquarters within the state. India has been adding paved single lane rural roads under its PMGSY initiative launched in 2000.

1.3.4. Rural Roads

The rural roads in India form a substantial portion of the Indian road network. These roads are in poor shape, affecting the rural population's quality of life and Indian farmer's ability to transfer produce to market post-harvest. Over 30 percent of Indian farmer's harvest spoils post-harvest because of the poor infrastructure. Many rural roads are of poor quality, potholed, and unable to withstand the loads of heavy farm equipment. These roads are also far from all season, good quality 2-lane or 4-lane highways, making economic resource flow slow, and logistical costs between different parts of India one of the highest in the world. For the development of these rural roads, Pradhan Mantri Gram Sadak Yojana, was launched in December 2000 by the Indian government to provide connectivity to unconnected rural habitations. The scheme envisions that these roads will be constructed and maintained by the village panchayats. In some parts of India, where the government has attempted to manage it directly as a local social spending program, this program has produced limited results and no lasting change over 10 years, in either the quality or quantity of rural road network.

In other parts of India, the Pradhan Mantri Gram Sadak Yojana and a sister program named Bharat Nirman (or Build India) have privatized the rural road construction projects and deployed contractors. The effort has aimed to build all-season, single lane, paved asphalted roads that connect India's rural and remote areas. A significant portion of funding for these projects has come from the World Bank and Asian Development Bank.

The national highways are very important, connecting metropolitan cities, state capitals, ports etc., throughout the country. The total length of National Highways in the state was 1269 kilometre in 1971, which increased to 1968 kilometre in 1981. There was a phenomenal improvement after that period in the National Highways Category as the introduction new National Highways were declared. This category of roads has increased to 3728 kilometre in 2001, increasing to 6572.15 kilometres in
2016. These roads were under direct control of central government and have been maintained by a separate wing of the state P.W.D. out of the Central Funds. At present there are about 23 National Highways which traverse the state with a road length of 6572.15 kilometres. Out of these, National Highway 13 is the longest National highway within the Karnataka state. National Highway 150-A runs north to Siriguppa, Bellary, Hiriyur, Chikkanayakanahalli, Nagamangala, Srirangapatna, Mysore and Nanjangud and is the second largest National Highway of the state (Ranganatha, 2016). National Highway 212 enters the state from Kerala State and connects Gundlupet and Mysore through Begur and Nanjangud. From Mysore it continues eastwards via T.Narasipur and it is connected to National Highway 209 near Kollegal.

The Karnataka state has recorded the highest number of deaths in the state due to road accidents.

![Fig 1.1: Number of Road Accident leading to Death from the years 2003 to 2011](image)

The number of deaths due to road accidents in the state of Karnataka stood at 6,195 in the year 2003. Since then there has been a rise in the death toll, topping off at 9590 in the year 2010. In the year 2011, the number of deaths fell by over 500 when compared to 2010.
1.4. ROAD ACCIDENTS

India is listed among the countries that have the highest number of road accident casualties in the world. A government statistic says that a death occurs every four minutes on Indian roads. Causes for road accidents are many; the congested city roads, bad road surfaces, flooding of roads, reckless driving, inadequate traffic management and so on and so forth. Between the years 2001 and 2011, more than a million people died in road accidents across India. In urban areas, fast growing of population, development of industrialization and technology is highly correlated with the increasing density of vehicles and the absence of proper safety measures to control them leading to accidents. Every road user is worried from these increasing incidences of road accident.

The accident or mishap is unexpected and unintentional event or regularly with lack of purpose or necessity. Either accident involving slightest one traffic road vehicle or anyone is killed or injured happening on a road in public movement is refers to a road accidents. Accidents are mainly general types are inspected to discover how to circumvent them in the future. The road accident is being recognized as big disaster in urban or city areas and its affect public harmony. Road accidents are one of the biggest killers in India. Over 10 lakhs people have been killed in road accidents in India in the last 10 years but the country is yet to have a stringent law on the issue.

Police reports, medical centres, Hospitals, institutions, and insurance information are a number of the assets for records used globally with regard to road traffic accidents; the commonest being the police and hospitals.

1.5. ROAD ACCIDENTS IN INDIA

Over 1, 37,000 people were killed in road accidents in 2013 alone, that is more than the number of people killed in all our wars put together. 16 children die on Indian roads daily. 5 lives end on Delhi’s roads every day. There is one death every four minutes due to a road accident in India. Drunken driving is one of the leading causes of road fatalities. One serious road accident in the country occur every minute and 16 die on Indian roads every hour. 1214 road crashes occur every day in India.
Two wheelers account for 25% of total road crash deaths. 20 children under the age of 14 die every day due to road crashes in the country. 377 people die every day, equivalent to a jumbo jet crashing every day. Two people die every hour in Uttar Pradesh – State with maximum number of road crash deaths. Tamil Nadu is the state with the maximum number of road crash injuries. The top ten cities with the highest number of Road Crash Deaths are Delhi, Chennai, Jaipur, Bengaluru, Mumbai, Kanpur, Lucknow, Agra, Hyderabad and Pune.

1.6. TYPICAL CAUSES OF ROAD ACCIDENTS

Road accident is becoming, to a greater extent, common in today’s world and contributes to a major number of deaths as a result. Road accidents are usually caused due to the following reasons in present days:

**Poor Road Designs** is one of the most important causes of road accidents. This can happen when roadways are not constructed properly and lead to conditions that allow for accident take place. Some of these include upkeep, unclear road signs and poorly placed guard rills, barriers, and speed bumps. (Apak, A, 2011). Lacking proper road markings and poor condition of road surface also makes it more likely for accidents to occur.

**Defects in vehicle** like low maintenance of vehicle, breakage of tie rod of a running vehicle, tyre bursting, wheel coming loose or failure of brakes.

**Human Negligence** like lack of traffic sense, overtaking from wrong side, using cell phone while riding the vehicles, over loaded vehicle, sleep-deprived driving and reckless driving.

**Drunken driving** (intoxicated) is a major cause in many serious accidents.

**Inadequate traffic signs** like absence of major road signs, cautionary road signs, information road signs and speed limit signboards.

**Weather condition** like heavy rainfall, hail storms, fog, snow and wind storms.

**Violating traffic rules** like driving without obtaining license, signal jumping, avoiding safety gears like seat belts and helmets, illegal bike racing within city limits.
General sight at road intersections is that the vehicles cross without caring for the light. The main motive behind Red light jumping is saving time and sometimes urgency. The frequent conception is that stopping at red signal is wastage of time and fuel. A red light jumper not only jeopardizes his life but also the safety of other road users. This act by one driver incites other driver to attempt it and finally causes chaos at crossing. This chaos at intersection is the main cause of traffic jams. Eventually everybody gets late to their destinations. It has also been seen that the red light jumper crosses the intersection with greater speed to avoid crash but it hampers his ability to judge the ongoing traffic and quite often crashes.

1.7. IMPACT OF ROAD ACCIDENTS

Road accidents cause both tangible and intangible costs to the economy. Some of the tangible costs include such as:

- Damage to the vehicle (replacement and repair costs), organization costs, Medical treatment, reduction in output due to injury and death and insurance costs.
- Road accidents cause direct impact on the social and physical environment. Whenever a person is involved in an accident, most likely the family will have to sustain the medical burden or, alternately, in the event of death, the whole family may become financially weak.

1.8. VEHICULAR DENSITY IN MYSORE

Before the independence the vehicles and road networks are so less in Mysore. The number of vehicles has been growing at 9 to 10 percent a year in the last few years in Mysore city. According to statistics available from the Regional Transport Office (RTO), the total number of vehicles registered in Mysore was 4, 95,513 as on December 31, 2010. The number of vehicles in the city was 4, 60,226 on December 31, 2009. The number of vehicles in Mysore in the mid-1980s was about 52,000 and it increased to about 80,000 by late 80s. Mysore had about 1.5 lakh vehicles on road by the mid-90s and their number more than doubled to nearly 3.5 lakh by 2006. The net impact is on the quality of life as people are spending more time commuting from one part of the city to another. As the city grows horizontally with the prospects of
creation of a Greater Mysore by incorporating potential “growth zones” into the city limits, the situation is likely to worsen. (Kumar, R. K., 2011)

1.9. TRAFFIC CONGESTION

Traffic congestion in Indian metropolis roads is extended enormously due to the growing rate of urbanization. Globalization of the Indian financial system and the improvement in economic fame of the residents has as well brought on better effect on the transport system. Growing insufficiency of public transport, growing price of automobile ownership and immigration of people to city outer edge has brought about big use of private modes, congestion the road system. The site visitor’s actions in metropolis roads were compounded by means of not unusual interruptions, ensuing in excessive decrease in velocity, most vital to congestion.

Traffic congestion in metropolis areas has broad problem observed by people of Central Business District (CBD), except it has now stretched and intensified within the city periphery and close via suburban areas additionally. People make use of mixture of modes of transport to assemble their travel require. The development in automobile technological know-how has brought in a combo of two wheelers and four wheelers available in the market same to ones financial plan and cause, thereby adding collectively more congestion. The homework of suburban areas will not be sustainable and isn't flourishing in containing the journey demand of the individuals inside the region (Hoover, 1984). The men and women from the newly developed areas travel closer to the town for their requirements adding extra congestion. The congested traffic flow has lead to enlarge in vehicular emissions which have spoiled the urban air superiority. Traffic congestion has a ways achieving multiplying possessions on the economic, climate, environment and universal exceptional of lifestyles.

Now not any of the cities in India has an affordable stability of the modal divide of diverse transport modes. Restricting the growth of the usage of motor vehicle doesn’t look to be possible in the close future, given the fiscal and other benefits of expanded mobility. Development of road infrastructure can't be matched with the transport demand as a result of financial and spatial restrictions. The available choice is to mitigate congestion with the aid of use of the accessible resources optimally. Steady
efforts were taken by way of the transportation authentic and authorities in developed countries to measure and devise method of reducing congestion. The causal reasons of congestion in Indian context need to be understood to reach at insurance policies for mitigation. A transparent understanding of the heterogeneous traffic operations on urban arterials and quantitative measure of congestion is required to plan policies to manage the usage of motor cars causing minimal damage to the environment. No longer have many reports been carried out in India to quantify congestion for the heterogeneous visitors drift prevailing on urban roads. For that reason, on this behalf, an effort has been made to construct a mathematical relationship to quantify traffic congestion for heterogeneous traffic flow. Traffic congestion may lead to the following issues:

- **Delays**: during the morning commute there is additional stress because delays caused by traffic can make people late for work or others places. Then, at the end of the day, the afternoon rush hour is again a frustrating time because the workday is done and people want to get home to relax and traffic is preventing it.

- **Road rage**: road rage is a senseless reaction to traffic that is common in congested traffic areas. If someone is not driving as fast as the person behind him thinks he should, or someone cuts in front of someone else it can lead to an incident that is dangerous to the offender and those around him on the road.

1.10. MAJOR REASONS FOR CONGESTION

Traffic congestion is always increasing vehicles in particular place with slower speeds and longer times and its enlarged vehicular queuing

- **Big vehicles**: big vehicles like lorry, trucks, bus compare to other vehicles these vehicles very huge ones. Unplanned cities the roads are very small, when this type vehicles arrived the cities may congested to the traffic.

- **No parking place**: If we are parking vehicles in no parking will causes traffic congestion
• **Absence of traffic signal**: if we are not putting the signals in suitable place and in necessary traffic place, heavy crowds may occur and it will cause traffic congestion.

• **Accident incident**: if any accidents happens in the traffics may cause heavy congestion.

• **Natural disaster**: sometimes Heavy rain, building collapse, tree fall, electrical pole fall, land slide in traffic roads may cause traffic congestion.

• **Road shows**: bicycle rally, bike ride shows and political rally may cause traffic congestion.

1.11. GIS IN TRAFFIC CONGESTION

A GIS offers an efficient means of entering, managing, retrieving and displaying spatial data. The components of a GIS-based system are hardware, software, data, procedures and people. The data includes graphic elements and non-graphical elements. For example, the graphic element may be a map of the roadway system and the non-graphical element may be an attribute table of roadway characteristics. In procedures, analysis and statistical techniques, other queries, and data-security issues may also be included. People involved include managers, computer scientists, planners, engineers and data users.

A GIS-based system is a good tool that can be used to manage and manipulate all transportation related data for the management systems. According to Rao, A. M. (2014), “Geographic Information System, over the years, has emerged as one of the efficient technological tools in the field of transportation engineering. It has shown great applications in a number of fields including transportation. Increasingly, urban and transportation planners and professionals are finding that the integration of traditional transportation research methods with the added value of GIS capabilities including integration of geographical spatial-analysis and cartography, provides a robust platform for both traditional and innovative transportation and traffic activities. The various advantages of GIS make it an attractive option to be used to face the emerging traffic problems. The advantage of GIS can be attributed to its capability to cope with the large volume of data with geographic spatial characteristics. GIS has a
large database storage capacity, which can integrate data from disparate sources. While working with traffic speed, integrating spatial and non-spatial data from different sources becomes a prime concern. Moreover, along with great data integration capabilities, it is also a great visualization tool as it produces relevant maps assisting in decision making process.”

As per Spear, B. D. (1992) “Geographic Information Systems (GIS) are much more than computer generated maps. A GIS is a sophisticated database management system designed specifically for spatially referenced data, Using location as the common reference, a GIS enables one to display different databases as layers on a map and then combine data in one layer with that in another using topological relationship. For example, with a GIS a transit planner can overlay a proposed bus route on an area database of census tract population and determine the potential market of bus riders residing within a quarter mile of the bus route. Since transportation is inherently a spatial activity, GIS is particularly well suited to be a platform for managing much of the data used in transportation applications. Moreover, rapid advances in microcomputer and graphics workstation technology during the past few years have moved GIS from the mainframe environment to the desktop of the transportation professional, where it is evolving into a basic analysis tool just like the word processor, spreadsheet, or database manager.”

1.12. ROAD ACCIDENT ASSESSMENT USING GIS

A significant unexpected outcome of transportation systems is road accidents with injuries and loss of lives. In recent years, the number of studies about the tools for analysing accidents and road design has increased considerably. Among these tools, Geographical Information Systems (GIS) stand out for their ability to perform complex spatial analyses.

According to (Saxena et.al, 2002), “GIS has its strength in providing capabilities to model the physical proximity of spatial features. The powerful aspect of GIS is the flexibility in modeling spatial objects to suit particular application requirement. It provides capability to store and maintain large data sets. GIS provides relational link between different streams of accident data – FIR Data, Inventory Data, etc. It provides facilities to understand one to many, many to many and many to one relation-ship,
which exists in spatial data. An expert may put his concentration on an intersection or a culvert or a type of accident or on a combination of parameters. GIS provides new capabilities of data comparison and analysis that were not available in non-GIS linear reference system. GIS enables the safety experts to compare accidents along a road way segment with land use and zoning-data or population and other demographic data to gain a better understanding of the relationship of crash incidents or the zone-data could be integrated with accidents records to provide a true picture. Visual ability of GIS permits the mapping of FIR data, Inventory data and geometry data. Maps can be created to show the accidents of several targets groups (Pedestrian, cyclist, intersection, etc.) but also of various subgroups of victims or accident circumstances.”

The mapping provides beside a spot/ intersection identification a way to establish zones and understanding of accident patterns. Patterns may cluster in linear or circular form or in other shapes.

In road safety management, an accident black spot is a place where road traffic accidents have historically been concentrated. They are road locations that have a record of large numbers of crashes. Reason for Black spots is noncompliance with Road Safety Norms during design, construction and operation of roads including National Highways. Most common Black spots are sharp drop or corner in a straight road so oncoming traffic is concealed, hidden junction on a fast road and poor warning signs at cross-roads.

1.13. WORLD WIDE TRAFFIC RELATED DEATH RATES

The annual global road crash statistics as per the Association for Safe International Road Travel (ASIRT) are as follows:

- Nearly 1.3 million people die in road crashes each year, on an average of 3,287 deaths a day.
- An additional 20-50 million are injured or disabled.
- More than half of all road traffic deaths occur among young adults in the age group 15-44.
- Road traffic crashes rank as the 9th leading cause of death and account for 2.2% of all deaths globally.
• Road crashes are the leading cause of death among young people ages 15-29, and the second leading cause of death worldwide among young people ages 5-14.
• Each year nearly 400,000 people under 25 die on the world’s roads, on average over 1000 a day.
• Over 90 percent of all road fatalities occur in low and middle-income countries, which have less than half of the world’s vehicles.
• Road crashes cost USD $518 billion globally, costing individual countries from 1-2 percent of their annual GDP.
• Road crashes cost low and middle-income countries USD $65 billion annually, exceeding the total amount received in development assistance.
• Unless action is taken, road traffic injuries are predicted to become the fifth leading cause of death by 2030. (Nachimuthu, K., 2016)

1.14. BACKGROUND OF STUDY

Road accidents and traffic congestion are the main terms which have received attention in the field of transportation geography. The accidents and traffic congestion varies in various roads. It depends on the width and length of the road and density of vehicles.

To understand any type of problem, it is necessary to investigate the geo-socio economic base of the study area. The problem selected for the study is to identify the road accident spots and traffic congestion; it also focuses on the length and width of the road, density of vehicles on the road and development of roads over a period of time. Thus the title of the study can be stated as, “A study on identification of Road Accident Spots and Traffic Congestion in Mysore City, Karnataka”.

1.15. LIMITATIONS OF THE RESEARCH

Not all accidents occurring in the city is registered with the City Traffic Police Department. Data of only those accidents that were registered were available. Furthermore, the data prior to the year 2013 regarding the solved accident cases were destroyed by concerned department. Hence, the location details of only registered accidents for the year 2013 were selected for the analysis.
1.16. OBJECTIVES:

The major aim of the present study is to assess the traffic congestions and road traffic accidents in Mysore City. The following objectives are designed to achieve the aim of the research:

i. To study the development of roads and vehicles in Mysore city.

ii. To analyze the traffic congestion in Mysore city.

iii. To identify the density of road accidents in Mysore city

iv. To suggest appropriate measures to reduce road accidents and traffic congestion based on the findings of the research.

1.17. METHODOLOGY:

The methodology followed for the present research is depicted in Fig. 1 below:

![Flowchart of the research methodology for the present study](image-url)
Toposheet surveyed in 1972-73 and 2005-06, and satellite images from Google Earth databases were used to digitize road networks in Mysore city for assessing the road network development. The secondary data were also collected from different departments like Mysore City Corporation (MCC), Mysore Urban Development Authority (MUDA) and Mysuru Regional Transport Office (RTO) to analyze the annual growth of vehicles registered in the city and the developmental activities in the road network.

Questionnaires were used to collect the opinion of road users regarding the traffic congestion within the city. Participants were selected randomly from local residents (100), roadside shopkeepers (50), traffic police personnel (20), bus drivers and conductors (50), Passenger Auto-rickshaw drivers (100), Taxi drivers (100), Goods auto drivers (50) and Truck drivers (20). GPS Crowd-source data from Google databases were also used to identify the typical traffic congestion. Using ArcGIS 10.3, traffic congestions were mapped for five different timings viz. 06.00am, 10.00 am, 02.00pm, 06.00pm and 10.00pm in both weekdays and weekends. They were classified based on the movement of vehicles namely, fast moving, slow moving and high congestion roads.

The secondary data collected pertaining to accidents registered with Krishnaraja, Devaraja and Narasimaraja Traffic Police stations in Mysore city were plotted using ArcGIS 10.3 software. The accidents were divided into different time periods viz. 06.00am to 10.00am, 10.00am to 02.00pm, 02.00 pm to 06.00pm, 06.00pm to 10.00 pm and 10.00 pm to 06.00am. The occurrences of accidents were also analyzed on the basis of different types of vehicles involved, like two-wheelers, three-wheelers, four-wheelers and six-wheelers and on the basis of the gender of the occupants involved in the accident.

Kernel density and optimized hotspots analysis were used in ArcGIS 10.3 to identify and study the accident prone areas. Finally, based on the findings of the study, appropriate measures to reduce the number of accidents and traffic congestion in the city are suggested.
1.18. ORGANIZATION OF THE THESIS

The thesis is organized into seven chapters

1. The first chapter covers the introduction to road transportation, road density, general classification of roads, road accidents, typical causes and impact of road accidents, vehicular density, traffic congestion and its causes, GIS in road congestion and accident analysis, background, limitation, objectives and research methodology of the study.

2. The second chapter deals with the review of literature from the research outcomes of scholars across the world on the areas like roads and road users, vehicles, spatio-temporal analysis of road accidents, GIS for road network and accident analysis and various policies.

3. The third chapter presents the profile of the study area including the history, location, physiography, drainage, geomorphology, soil, transport, land use land cover, demography, climate, education, economy, tourism, waste management and industries.

4. The fourth chapter deals with the development of roads and types of road networks within city and the growth in the number of all major types of vehicles registered.

5. Fifth chapter deals with the assessment of traffic congestion within the city limits at five major time periods of 06.00am, 10.00am, 02.00pm, 06.00pm and 10.00pm for both weekdays and weekends.

6. The sixth chapter covers the incidences and location of all registered accidents and fatal accidents, and traffic sub-division-wise, time-wise, vehicle-wise and gender-wise assessment of accidents and the density of accidents.

7. Seventh chapter provides the findings of the study, suggestion to overcome the traffic congestion and road traffic accidents issues and a brief conclusion of the research.