COMPARATIVE ACCIDENT STUDY ON THREE SELECTED NATIONAL HIGHWAYS IN BANGLADESH.

by

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ABSTRACT

A developing country like Bangladesh is now experiencing a serious road safety crisis and is predicted to worsen in the coming years. Road accidents occur mostly on national highways and the victims of road accidents are predominantly pedestrians (about 48%), rural people who are ignorant of road crossing rules as well as young children. Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways are very important which are more vulnerable to danger. Accident comparisons on these three national highways are done in this study.

This study is conducted seven years accident data from 2000 to 2006 on Dhaka-Chittagong (N-1), Dhaka-Sylhet (N-2) and Dhaka-Aricha (N-5) national highways. Accident per kilometer on Dhaka-Aricha national highway is 1.84 times more than Dhaka-Chittagong and 3.4 times more than Dhaka-Sylhet national highway. Accident fatalities on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways are 69%, 74% and 64% of total accident respectively. Accident involved due to large bus is about 29%, 32% and 38% and trucks are about 40%, 28% and 30% on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway respectively. Maximum accidents are observed on Dhaka-Chittagong and Dhaka-Aricha national highway is 12% and 19% respectively in between 10.00 A.M to 12.00 P.M. on the other hand 16% on Dhaka-Sylhet national highway in between 16.00 P.M to 18.00 P.M. Accidents observed more on rural areas over urban areas which are about 89%, 88% and 91% of total accidents on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways respectively. Average daily traffic of Dhaka-Chittagong national highway is around 2.3 times more than Dhaka-Sylhet and 1.7 times more than Dhaka-Aricha national highway. Small buses and trucks are about 38% of ADT for Dhaka-Chittagong and Dhaka-Aricha and 49% of ADT for Dhaka-Sylhet national highway. Trucks involved in accident are comparatively more over other vehicles on three national highways which are around 29%. Accident and casualty occur significantly more on selected site and node on Dhaka-Chittagong and than flowed by the selected other site and nodes on Dhaka-Aricha, Dhaka-Sylhet national highways.

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LIST OF ABBREVIATIONS

ESCAP = United Nations Economic and Social Commission for Asia and the Pacific

GRSP = Global Road Safety Partnership

ADT = Average Daily Traffic

NRSC = National Road Safety Council

ARC = Accident Research Center

BUET = Bangladesh University of Engineering and Technology

RHD = Roads and Highways Department

PIARC = Permanent International Association of Road Congresses

MAAP = Microcomputer Accident Analysis Package

GIS = Geographical Information System

NH = National Highway

UK = United Kingdom

FIR = First Information Report

S.P = Superintendent of Police

AIG = Assistant Inspector General

ADU = Accident Data Unit

RSC = Road Safety Cell

CHAPTER-1

INTRODUCTION

1.1 General

Travel, and especially road travel, is one of the more hazardous activities which people in developed countries undertake. Each year, some half million people die and 10-15 million people are injured in road accidents worldwide (Ogden, 19960). This situation is rapidly worsening in developing countries causing a serious challenge for tackling the road safety problem. In 2003, an estimated 430,000 persons were killed and more than 2 millions were injured in accidents on the roads of Asia and the Pacific. More than half of the world's traffic fatalities are in the ESCAP region. The number of road users killed in accidents has increased rapidly in Asia in recent decades. Globally about 1 million deaths and 15 million injuries occur on roads each year (Jacobs, et, al. 1977).

In Bangladesh, road accidents and injuries are now a growing and serious problem and safety situation is very severe by international standard. Nearly about 37% accidents occurred in national highways, 12% in regional roads and 15% in feeder roads (Newaz, 2006). Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways play a vital role in inter regional road transport of this country. This study lays emphasis on comparative accident analysis among above stated three national highways based on severity, accident involved vehicle types, period and area of accidents on highway and comparative black spot study on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways. Moreover, this study also lays emphasis on comparison of average daily traffic with accident among three selected national highways.

Traffic flow in a particular road may vary over hours, days, months, years etc. Traffic flow parameter such as average daily traffic (ADT) and directional traffic distribution on a specific highway has important aspect in terms of both geometrical and structural highway design. In the developed countries, the transport authorization monitor, collect and preserve traffic flow data in a continuous basis and in a systemic form to be able to utilize

those for analyzing traffic flow characteristics as well as determination of future traffic on the basis of traffic growth pattern. This study also lays emphasis on average daily traffic (ADT) and average vehicle speed on Dhaka-Sylhet National Highway.

1.2 Statement of the Problem

Road accidents in Bangladesh claim on average 4000 lives and injuries another 5000 every year (NRSC, 2002-2004). In developing countries like Bangladesh, the relative safety of land base public transport modes are bus, coach, train and freight are transported by also these modes including truck. High risk experienced by so called vulnerable road users (pedestrian and cyclist) and the extreme hazard faced by motor cyclist. Road construction followed standard geometrics with least concern for road safety. In Bangladesh most of the roads and bridges did not have walkways and other required road safety features. The road intersections, blind curves, and bridge approaches were the most vulnerable spots for the motorists, as well as the pedestrian. Typically the principal factors which contributes to accidents are adverse roadside environment, poor detail design of junction and road section, excessive speeding, over loading, dangerous overtaking, reckless driving, carelessness of road uses, failure to obey mandatory traffic regulations, variety of vehicle characteristics and defeats in the vehicles. Others include a low level of awareness of the safety problems by the policy makers, inadequate and unsatisfactory education, safety rules and regulations and inadequate and unsatisfactory traffic law enforcement and sanction. As stated earlier that in Bangladesh the required parameters for evaluation of road facility, planning or designing are not available. Instead those of developed or neighboring countries are often used for the purpose. Design considerations and performance evaluation of highways is not possible using either incorrect or assumed traffic data. This may the road networks to be inadequately facilitated or over designed.

Only police department performs the road accident data collection in Bangladesh and many other developing countries. The widespread under reporting and incomplete collection of specific details of accident data are, however a major problem. This limits proper accident analysis to be carried out towards improving road safety. Losses of lives,

personal injury and property damages as a result of road traffic crashes are common daily phenomenon. No efforts have so far been made to estimate the economic wastage occasioned by traffic crashes in Bangladesh. This failure often limits the understanding of the safety issues in various planning and management related activities by the concerned officials. In Bangladesh with the present level of medical services, there is little scope to provide the prompt and necessary medical attention to injured people, particularly soon after an accident. In Bangladesh road traffic accidents claiming lives of more than 4000 people each year as reported by police (Haque, 2003). The national trend of police reported road accidents, fatalities and injurious for the period 1993-2000 in Bangladesh is presented in table 1.1

Table 1.1: Police Reported Road Accidents in Bangladesh (1993-2000)

Year	No. of accidents	No. of fatalities	No. of injuries	Total casualties	Fatalities/ 10000/ vehicles
1993	3140	1495	2409	3904	122.1
1994	3013	1597	2686	4283	107.1
1995	3346	1653	2864	4517	110.1
1996	3727	2041	3310	5342	112.1
1997	5453	3162	5076	8238	138.2
1998	4769	3085	3997	7082	128.1
1999	3942	3314	2620	5934	140.4
2000	3970	4046	2270	6316	162.9

It also includes the fatality rate per 10000 motor vehicles on the road. It is clear that the number of fatalities has been rapidly increasing particularly in recent years. The number of fatalities is 1495 in 1993 but in 2000 it becomes 4046, that means after 8 years the fatality rate increased nearly about three times. It is also found that the fatality rate (fatality/10000 vehicles) has increased from 122.1 in 1993 to 162.9 in 2000 which shows almost 1.33 times increasing after 8 years.

1.3 Objective of the Study

The specific objectives of this study are as follows:

(i) To determine the characteristics of the accident from different accident distribution pattern on three national highways.

(ii) To make a comparative accident analysis by using available accident data between three national highways.

(iii) To observe the relationship between average daily traffic (ADT) and vehicle speed with accident.

(iv) To make a comprehensive analysis on accidents and detail engineering investigations on different black spots with probable causes of accidents and remedial improvements.

1.4 Outline of Methodology

The first task is to review the relevant literatures to broaden the understanding of various characteristics of accidents in particular relation to geometric and structural design of pavements. Moreover, reviewing previously performed studies in the related topic of accident, a process of these studies is summarized in the following ways.

The three corridors will be selected in consideration of availability accident data. For selected three corridors necessary data for this study will then to be collected. During this study seven years accident data which will be based on accident severity, accident involved vehicle class, period of accident, area of accident etc on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha highways will be collected from Accident Research Institute (ARI), BUET, Dhaka. Detail diagnosis will be done by these available data.

Around ten accident black spots will be selected with available accident data based on accident casualty, total accidents, hour of accidents, environmental factors etc. by using available black spot definition. To make a comparison of black spot nodes and junctions two nodes and two junctions will be selected on each national highway. These analysis data will also be collected from Accident Research Institute (ARI) BUET, Dhaka-1000.

Detail technical investigation of five high accident frequency location and remedial measures will be done in this study. The technical investigation will be included all geographical and technical information such as spot identification, lane width, shoulder width, sign, signal, marking, parking, road divider, barrier, footpath, curve, contributing factor of accident for selected black spots which will be elaborately described with remedial measures. Average daily traffic data will be collected from Bhairab-Ashuganj toll plaza and RHD; to make a comparison of ADT with accident among Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways.

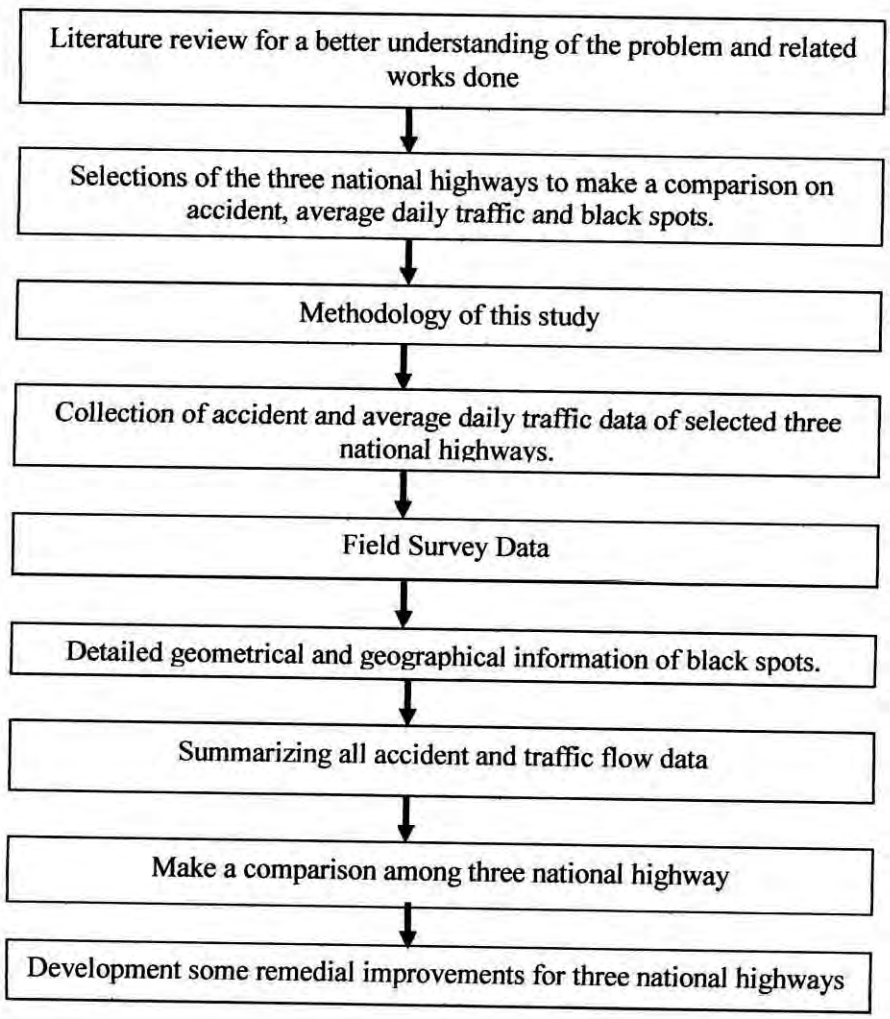


Figure 1.1: Flow Chart of the Study Methodology

1.5 Organization of the Thesis

The research works performed in this study are divided into different topics and presented in seven chapters. A detail introduction to the general and statement of the problem is presented in the first chapter. This chapter also contains the objective and methodology of the study along with brief description of the study plan.

Chapter 2 presents the literature review of related topics. In this chapter the definition of the related terms, guidelines for accident analysis, accident factors and economic analysis, black spots definitions, ADT and vehicle speeds etc which are previously performed similar works have been described.

In chapter 3, the methodology of this study is described. This covers the highway selection, data collection procedure, data processing and frame work development process used in this study.

Chapter 4 contains the comparative accident analysis of Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha National Highways. The analysis based on accident severity, accident involved vehicle class, hour of accident, accident frequency area etc with detail results and discussions.

Chapter 5 contains comparative analysis of average daily traffic and accident on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway.

Chapter 6 presents comparative accident analysis among two black spot nodes and junctions on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway. Detail analysis of several accident black spots with available data, geographical and geometrical information, probable cause of accident and remedial improvement measures are also made for Dhaka-Sylhet national highway.

The conclusion of the entire study along with summary of study results is presented in chapter 7. This chapter also contains suggestions and recommendations for further study.

CHAPTER-2

LITERATURE REVIEW

2.1 Introduction

The term accident is used to mean an event that produce or has a potential to produce an injury (Berger and Mohan 1996). An accident which occurred or originated on a road open to public traffic resulting in either injury or loss of life or damage of property, in which at least on moving vehicle was involved. Some person thinks that accidents are unpredictable, random and therefore not preventable. Actually the events which produce damage to people, are non-random, have identified risk factors and involved interaction among people, vehicles, equipments, physical and social environment. In this study the term "accident" is used to denote the events which produce damage to people and vehicle due to the movement of vehicles.

Everyone recognizes that, in today s world, transportation is a key element of the global economy. It has changed the face of employment, trade, family life and health care, bringing benefits that were unimaginable 100 years ago. However, the price we are paying in form of road crash mortality and morbidity for such benefits is too high. The shock and grief these events cause are all too well-known throughout the world. Their impact is particularly higher in poorer countries, where 90% of the road fatalities occur (Ahmed, 2007).

The primary objective of any accident study is to provide free, safe, and quick traffic movements on the highway. The accident problem is of very complex nature as so many factors involved in its occurrence. During the literature review on previously performed studies in Bangladesh on related terms of accidents, it was revealed that several analyses was done for different corridor including Dhaka-Chittagong and Dhaka- Aricha national highway for different research work. Several research reports have been studied and they have been summarized in these chapter. This chapter also contains brief discussion on

several methods and guidelines of accident black spot in different country based on their standards.

2.2 Definition of the Related Terms

Before going into the detail of this study, it is important to get familiarized with the terms related to Accident, black spot, Traffic flow characteristics and speed of vehicle study. Therefore, in this section, the important parameters of accident analysis, black spot analysis, traffic flow analysis and vehicle speed analysis, which are frequently used in this study, are described in brief.

National Highways

In Bangladesh RHD defined national highways as when it connects the national capital with divisional headquarters, old district headquarters, port cities and international highways (RHD, 1996). In RHD definition, for category A type national highway crest width 12.2m, pavement width 7.32m, shoulder width 2.44m and for category B type national highway crest width 12.2m, pavement width 5.5m, shoulder width 3.36m.

Casualty

Any person killed or injured as a result of an accident is known as casualty.

Fatal Accident

An accident in which one or more persons are killed on spot is called fatal accident.

Seriously/Grievous Accident

A person who is injured and admitted to hospital as result of an accident and who does not die as a result of those injuries with in 30 days of the accident.

Non-collision type accident

Accident of motor vehicles which occurs without hitting other vehicles and or any objects is called non-collision type accident.

Collision type accident

When motor vehicle hits pedestrian, another vehicle in traffic, animal, fixed objects etc in an accident.

Passenger

Any people other than the controllers, who are on boarding, entering, alighting or failing from a road vehicle at the time of accident, provide a portion of the person is in on the road vehicle.

Pedestrian

Any person who is not on boarding, entering, failing from a road vehicle at the time of accidents is called pedestrian.

Traffic Volume

Traffic volume is defined as the number of vehicles that pass a particular point along a road way or traffic lane per unit of time. Volume is a measure to quantify the traffic flow and is commonly measured in units of vehicles per hour, vehicles per day (Zaman, 2006).

Average Daily Traffic (ADT)

It is defined by the average number of vehicles that pass a particular point during a period greater than one day and less than one year. It is determined by dividing the total number of vehicles within a period of days (Zaman, 2006). The ADT is readily obtainable where continuous counts of traffic are available. ADT volumes are useful in economic study of highway and also in the design of the structural elements of the road.

Spot Speed

It is the instantaneous speed of the vehicle as it passes a specified point on the highway.

Average Speed

It is the average of spot speeds of all the vehicles passing a specified point on the highway.

Running Speed

This is obtained by dividing the distance covered by the time during which the vehicle is actually in motion.

2.3 Accident Study

Accidents may occur due to mistake carelessness and deliberate action of road users. It also occurs due to vehicle failure and also due to road surface characteristics. Generally the accident study is carried out for the following purposes

- To evaluate the existing facilities and to give support to the proposed design.
- To know the basic causes of accidents and suggest remedial measures at potential points.
- To justify economically, the proposed improvements.
- To compute financial loss due to accidents.

Typical modes of vehicular accidents are summarized as

- A moving vehicle collides with parked vehicle.
- Two vehicles approaching from different directions collide at an intersection.
- Head-on collision of two vehicles approaching from opposite directions.
- A moving vehicle collides with a stationary object.

2.3.1 Accident Involving Factors

Four basic components involving of the road transport system are following

Human factors

The road users responsible for the accidents may be driver of one or more vehicles in involved the pedestrian and or the passengers.

Drivers

Driver is one of the vital road user elements to cause an accident. So the driver's fitness is a major factor for safe driving. Excessive speed and rush driving, carelessness, violations of rules and regulations, failure to see and understand the traffic situation and road sign and signal, temporary effect due to fatigue, sleep or alcohol and physical and mental conditions are responsible for creating road accident.

Pedestrians

Lack of knowledge regarding road users' traffic rules and regulations, violations of regulations and carelessness in using the road way are the main reasons for road accidents. In adequate pedestrian facilities also lead to accidents. Pedestrian facilities such as side walks, cross walks, special pedestrian barriers, pedestrian refuge islands, pedestrian tunnels and over pass should be design properly to reduce accidents.

Vehicular Factors

The following vehicular factors are mainly responsible for accident

- Failures of brakes, defeats in steering system and signalizing devices, tyre bursts, deviation from specification such as overhanging length, width causes accidents.
- Presence of vehicles of varying speed operational characteristics in the same traffic creates hazards and conflicts and thereby may produce accident.
- Overloading of goods and passengers is another vehicular factors which causes road accidents.

In Bangladesh the motorized vehicles play a major role in transport. The vehicle such as rickshaw, van, push car has no light during night which causes also accident.

Environmental Factors

Environmental conditions are mainly sun-light, rain, dry, wet and weather conditions such as mist, fog, snow, dust, smoke or heavy rainfalls restricts normal visibility and make driving unsafe. Moreover road surface become slippery and causes skidding of vehicles which can contribute a large amount of accident.

Road Condition

Road surface may be in damage condition, may be having pot holes, ruts etc. are the common vehicle failures.

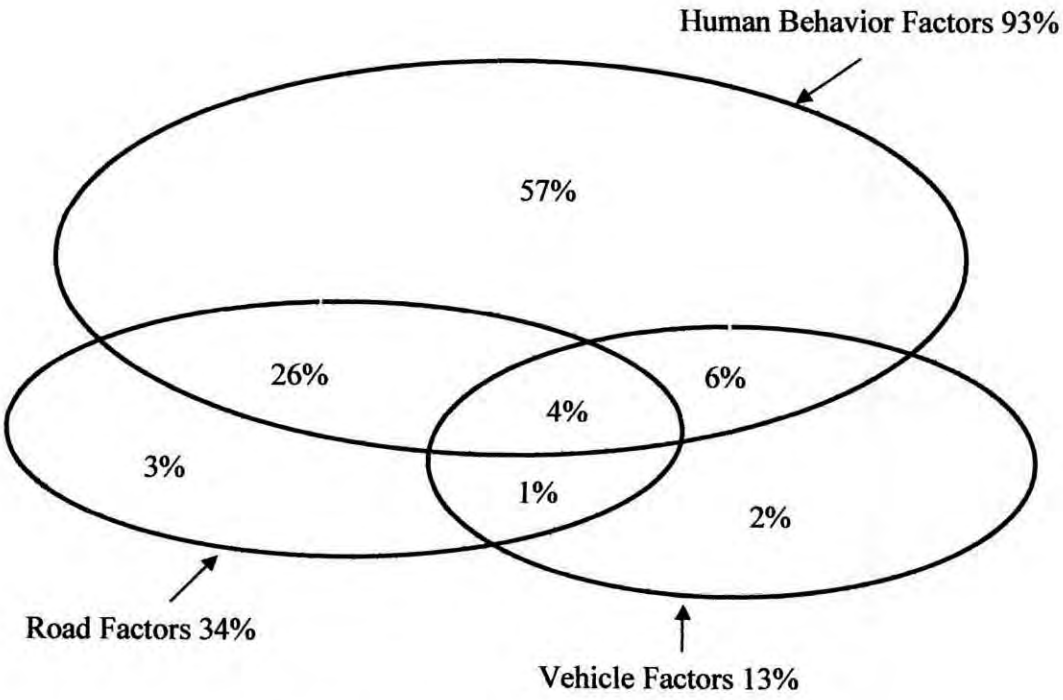


Figure 2.1: Accident Contributing Factors

Source: PIARC Road Safety Manual, 2003

Road Geometrics

Road may be having improper sight distance, inadequate width of the shoulders, in proper curve design etc are also causes of accident.

Animal

Stray animals on the road make disturb to the driver and sometimes causes accident.

Mixed Traffic

A traffic stream having vehicles of varying range of speeds and characteristics creates traffic hazard and may causes accidents. The slow moving vehicles often block the way of fast moving vehicles and causes road accident. Lateral moving tendency of mixed traffic stream is also vital cause of road accidents.

Other Factors

Incorrect signs or signals, gate of level crossing not closed when required, ribbon development, badly located advertisement boards or service station etc sometimes causes serious accident.

2.3.2 Methods of Accident Analysis

Traffic accident research methods can be broadly categorized under three major headings such as;

a) Theoretical
b) Empirical and
c) Simulative.

Maximum amount of accident research has been attributed to the empirical analysis of accidents. Accident analysis is also conducted both at micro and macro level. Macro scale considers accidents occur in a town, country, region, state or world wide. On the other hand micro scale considers accidents occurring on a specific network, facility, location such as curve or intersection, airport, train station, highway exit, interchange etc (Hasan, 2007).

Moreover most accident research has been conducted on the basis of empirical method which involves the use of sets of data obtained information of observations of counts. These data are analyzed under two categories such as

a) Detail technical investigation of accident events and
b) General surveys of system wise accident patterns.

The general category of accident study is mainly oriented towards providing information of accident data in a more or less non-technical form. It is associated with describing rate i.e. accident numbers or fatality number in term per unit population, registered vehicle etc and identified hazardous road locations. The technical category of accident study is based on specification collision diagram to determine the pattern of accident types, the reason of accidents and thus give direction toward appropriate remedial measures (Hasan, 2007).

Macro Scale Analysis

The macro scale analysis accidents are summarized in a table, providing a record of performance of a region or a country in terms of one or more transport mode. Accidents occurrence severity (fatality, injuries, property damage) ant rates provide a statistical illustrative of safety performance. In this study, this method is adopted in order to understand trend in accident occurrence (Hasan, 2007).

Micro Scale Analysis

Micro scale accident analysis can be subdivided into the study of individual accident, known as accident reconstruction and study of high accident locations. Location analysis in conducted at high accident frequency locations. The studies are based up on the individual accident reports as a basis document. In our study this method is also adopted is accident black spot identification (Hasan, 2007).

Statistical Analysis of Accident

The statistical analysis of road accidents helps to assess the effectiveness of various measures to decrease the accident rate. Thus the analysis estimates the relative safety of road stretches. As the mobility increases the probability of accident also increases. The number of accident found to increase with the number of road users or the number of vehicles and pedestrians on the roads. As the vehicle movements and the population are on the increase, the total numbers of accidents in the study area are likely to increase year after year. The reliability of the statistical analysis of accidents depends mainly on the reliability of the accident data; obtain from accident records (Khanna et al., 2001).

Analysis of Individual Traffic Accidents

Each of the road accidents is analyzed by the traffic engineer to draw sound conclusion. In this study it is necessary to compute the original speeds of the vehicles involved in various types of accidents (Khanna et al., 2001).

2.3.3. Accident Data Records

The various steps involved in traffic accident studies are collection of accident data, preparation of accident report, location file and diagram, and application of the above records for suggesting preventive measures. Flowing steps are done before accident analysis:

Collection of Accident Data

The collection of accident data is the first step for in the accident study. Standard form for collecting the accident data is prepared first aspects for data collection. The details to be collected are mentioned bellow here.

General

The accident report form contains date, time, persons involved in the accident and their particulars, classification of accident like fatal, grievous, simple and collision type of accident.

Location

Description and details of the location of accident are reported in the form.

Details of Vehicle Involved

In this item registration number make and description of the vehicles, loading condition, and vehicular defeats are summarized.

Nature of Accident

In this item condition of the vehicles involved, details of collision, pedestrian and objects involved, damages, injuries and casualty etc are described.

Roads and Traffic Condition

Details of road geometrics, whether the road is straight or curved, surface characteristics such as dry, wet or slippery etc are mentioned. Traffic condition – type of traffic, traffic density are precisely reported in the report form.

Primary Causes of Accident

In record form, various possible causes of accident are included for primary idea.

Accident Cost

In this item, property damage, personal injury and casualties are reported.

Accident Reports

The police should be reported to the police authorities who would take legal actions especially in more serious accidents involving injuries, casualties or sever damage to property. Accident report of the individuals involved may be separately taken. The accident data should be collected as given above the accident report is prepared with all the facts which might me useful in subsequent analysis, claims for compensation, etc.

Accident Records

The accident records are maintained giving all particulars of accidents, location other details. The record may be maintained by means of location files, spot maps, collision diagrams and conditions diagrams.

2.3.4 Accident Investigation

The scientific approaches for accident investigations suggested are summarized below.

- It is suggested that a mobile laboratory may be kept ready in every city.
- A bus equipped with essential instruments to measure the alcohol content in the breath, reaction time and other drivers characteristics, skid resistance of pavement surface etc and
- A traffic engineer and his assistant may form a proposed mobile laboratory which should reach the accident spot as soon as possible after an accident

2.3.5 Accident Rate Reduction Measures:

The various measures to decrease the accident rates may be divided into three groups.

(i) Engineering

(ii) Enforcement and

(iii) Education

These three measures are generally termed "3 – Es" (Khanna et al., 2001).

Engineering Measures:

Engineering measures are described in terms of Road Design, Preventive Maintenance of Vehicle, Before and After Studies, Road Lighting etc.

Road Design

The geometric design features of road such as sight distance, width of pavement, horizontal and vertical alignment design details and intersection design elements are checked and corrected if necessary.

Preventive Maintenance of Vehicle

The breaking system, steering and lighting arrangements of vehicle plying on roads may be checked at suitable intervals and heavy penalties levied on defective vehicle

Before and After Studies

After making the necessary improvements in design and enforcing regulation, it is again necessary to collect and maintain the record of accidents "before and after" the introduction of preventive measures to study their efficiency.

Road Lighting

Proper road lighting can decrease the rate of accident during night. Lighting is particularly desirable at intersections, bridge site and at places where there are restrictions to traffic movement.

Enforcement Measures:

The various measures of enforcement that may be useful to prevent accident at black spots are described bellow.

Speed Control

To enable drivers of buses to develop correct speed habits tachometers may be fitted so as to give the record of speeds. Also a surprise check on spot speed of all fast moving vehicles should be done at selected locations and timings and legal action on those who violate the speed limit.

Traffic Control Device

Proper traffic control device like signs, marking or channelizing islands may be installed wherever found necessary.

Training and Supervision

The transport authorities should be strict in testing and issuing license to drivers of public service vehicles and taxis.

Medical Check

The drivers should be tested for vision and reaction time at prescribed intervals.

Educational Measures:

Educational measures are included Education of Road User, Safety Device which are described below

Education of Road Users

The passengers and pedestrians should be taught the rules of road, correct manners of crossing etc. This may be possible by introducing necessary instruction in school for the children.

Safety Device

Imposing traffic safety week when the road users are properly directed by the help of traffic police and transport staff is a common means of training the public these days

2.4. Accident Black Spot Study

2.4.1. Definition of Accident Black Spots

For identify accident black spot, different country use different criteria for analysis. The available criteria for identify accident black spots are described bellow.

- In Belgium, Denmark, Australia use the criteria which was, a location is said to be dangerous or black spot when its priority value (P) equals to or more than 15 with in three years. Two methods such as Percentage Deviation Value and Hierarchical Bayes Model are elaborately used of this analysis.

  The developed formula,

  P = X+3*Y+5*Z

  Where, X = Total no. of light injury,

  Y = total no. of serious injury,

  Z = total no. of deadly injury.

(Deadly injury means, if the person die within 30 days after admission in hospital due to accident.)

- According to the Land Transport Safety Authority, Newzeland, the definition of a black spot is "A site 5 or more crashes or 3 or more Serious or Fatal crashes have been recorded in a five year period, with in a 510m diameter for rural areas or a 70m diameter for urban areas."

- According to United Kingdom, a spot is treated as accident black spot if total number of accident is equal to or greater than 12 with in three years. Microcomputers are being used to analyze road accident data. TRL's Microcomputer Accident Analysis Package (MAAP)

- High risk sites and sections in Norway are identified on the basis of the Norwegian accident register. An accident high risk site is defined as a place with a maximum length of 100 meters, where at least four injury accidents have been reported to the

police in the course of 4 years. A high risk road section is defined as a stretch of road of maximum length of 1 km, where at least 10 injury accidents have been reported to the police over a four year period (Avenoso, 2003).

- In Bangladesh, the RHD definition of accident black spot identification is if in a spot at least 12 accidents including 3 fatalities occur during the study period of three years (RHD Report, 1999).

As it is observed that in Dhaka-Sylhet national highway is comparatively safer road and no spot is found which fulfill the RHD blck spot criteria, so in this highway black spots are identified by using partially of RHD criteria which is if minimum three fatal accidents occurred with in consecutive three calendar years.

2.4.2 Method of Black-Spot Investigation

Several methodologies are established in different countries for accident black spot analysis. Here available some methodologies are summarized.

Using MAAP

Accident Investigation involves a continuous programme of identification of accident black-Spot locations, analysis of the factors involved, site studies, and implementation of countermeasures and evaluation of their effectiveness. MAAP uses three systems for locating accidents which are (Hills. et al., 1991).

- Rural highways - kilometer posts
- Urban areas - node/link/cell system
- Any area - grid co-ordinate system.

The TRRL Microcomputer Package MAAP has a number of options for identifying locations with high accident rates. These are bellow (Hills et, al, 1991).

- Plotting accidents along a (Nodal) Route in a city
- Listing the worst Links or Nodes (Junctions) in a city
- Plotting a co-ordinate accident map for a city
- Listing the worst accident sites by map co-ordinate

- Plotting accidents along a rural highway using kilometer posts
- Listing the worst accident sites by kilometer.

Before and After Studies

The analysis of accident distribution of a spot and properly application of the remedial improvement for that spot, after several suitable periods another analysis of accident distribution observed and difference or change between two characteristics evaluated are done by this method. That means when work has been implemented it is necessary to consider after a reasonable period

- To see if an individual project was successful ie. it had less accidents
- feed-back the information into the system to see if the particular solution can be used elsewhere.

Following analysis is generally conducted for this method.

- The severity of the accident, e.g. fatal, injury or property damage only
- The accident contributory factors present in the accident, these factors may be assigned to the driver, the location or the vehicle.
- The accident category, e.g. pedestrian, left-angle, left-turn, rear- end, head-on, and various run-off-road collisions

Hiyari-Hatto Method

It is an empirical study on identifying potential black spots through public participation approach which is initiated in Japan. It is a traffic psychological method to encourage road users to participate/involve in the traffic safety program in order to elicit information through their expression of potential accident experiences that almost occurred/caused them dead or injured. This public participation activity through Hiyari-Hatto marks a quantum leap towards the substantial reduction of road traffic accidents. This method provides opportunity to researchers to collect valuable data on road safety through a participation of public on the expression of their Hiyari-Hatto which helps significantly to identify the potential black spot locations prior to traffic accident occurrence. This Hiyari-Hatto method seems applicable to investigate road safety situation in Thailand.

Hiyari-Hatto has been widely used in various manners, i.e., group discussion, workshop and survey for investigating the safety matter within community or organizations and secondly it is quite painstaking to identify all potential hazardous and /or existing black spots on existing roads in the selected area using only Hiyari-Hatto method. Hence, the study employed:

- A direct public participation approach,
- Cognitive map technique method
- A face-to-face revealed preference survey and
- Utilization of Geographical Information System (GIS) application

List

Based on accidents statistics, a list is drafted indicating concentrations with the highest frequency of accidents involving injury. The list is then divided into junctions and road links, the latter specifying the number of accidents involving injury per kilometer (Avenoso, 2003).

Inventory Map

Usually managed by the road owner or road authority, this is a regularly updated map with a record of all accidents. Each new accident is located on the map with a colour pin and the colour of the pin varies according to the seriousness (injury/fatality) of the accidents. This provides a quick way to visualize the most dangerous spots and sections of roads kilometer (Avenoso, 2003).

Number-based methods involving total accidents analysis

This methodology contains three types of accident analysis which are bellow

- Total accident based analysis,
- Total losses (fatal accident separately weighted) based analysis and
- Casualty based analysis.

Rate-based methods including accident rate

This methodology contains two types of accident analysis such as;

- Accident rate based analysis and

- Casualty accident rate based analysis

Combination methods

This methodology also contains three types of accident analysis which are

- Accident rate after number,
- Accident number after rate and
- Casualty accident rate after number

Route – km post stationing

Stationing is the traditional and most commonly used method for road location identification. Road stationing is similar to a node system. They both identify location with distance between known points. This method uses values assigned to road sections. Each road has an original station (zero point) – the distance from this point defines each location. Distances are indicated by km post markers. If the distance between posts is too long, as it is often the case in rural areas, there may be certain problems with the localization of road accidents. A sufficient density of stationing posts is, therefore, of immense importance. The markers should be typically placed every 200 meters at main roads, and at 500 meters on other roads. Disadvantage of this system is its burdensome inadaptability to infrastructural changes that result in a change of the road length (e.g. bypasses). Therefore, police staff at road accident departments should have some sort of stationing review to keep it updated every year. Review should cover all roads in the relevant area with the values of stationing at every orientation point.

2.4.3 Techniques of Black Spot Management

- Mass actions: Measures for accident reduction on locations having common accident factors (for example, at roundabouts).
- Route actions: On roads having above average accident rate for their specific type.
- Area actions: Remedial measures over an area with an accident rate above a pre-determined level (for example, urban areas).

2.4.4 Accident Data

It is true that it is difficult for many countries to develop and operate such systems which can provide a road engineers and or a decision makers with all the relevant and necessary information of any types of accident. For this three levels of data sets are considered:

- Minimum data
- Road and traffic data
- Additional data

Minimum Data

A minimum set of data can provide road engineers with relevant information necessary for basic accident causation investigation (Mikulík, et al., 2007).

The minimum data can be identified as follows

- Accident identification (a unique number-based system)
- Time (the date, hour, minute, day of week)
- Location
- Accident type, vehicles involved (number, type) and accident consequences

This elementary set of data can be easily introduced in countries without any accident recording system as an early step for a system based reporting system. It doesn't require huge financial resources, and only limited human input is needed.

Road and Traffic Data

This set of data provides road engineers with relevant road infrastructure information linked with the location of the accident and other circumstances and factors contributing to the accident occurrence (Mikulík, et al., 2007).

The set of data can include features as follows

- Road description (type of intersection, road number, road category, cross section etc)
- Specific places/objects (Crossing, bridge, bus stop, parking place, petrol station etc)
- Road alignment (evident deficiency or not, slope, narrowing etc)
- Road surface (type, permanent state, actual conditions – e.g. snowy, wet surface)
- Road signing and marking (availability, condition, location etc)

- Roadside obstacles (tree, column, bridge)
- Visibility conditions (clear, limited by alignment, obstacles)
- Weather conditions (dry, fog, rain, snow)
- Traffic control (traffic lights, road signs, policeman)
- Main causes of accident (speeding, overtaking, and right of way)

This level of reporting system can be implemented in countries with a developed road administration that has been introduced to its operation. A link with an existing road inventory database is recommended.

Additional Data

This set of information contains features related to the vehicles and persons involved in the accident (Mikulík, et al., 2007).

The data to be gathered are as follows

- The driver (category of license, driver experience, sex, age, nationality, education)
- Impairment of the driver (alcohol, drugs, others)
- Condition of the driver (alert, tired, impulsive, sudden indisposition, suicidal)
- Use of restraint devices (helmet, safety belt, child seat)
- Condition of the pedestrian (alert, impaired by alcohol/drugs) etc.

2.5 Accident Studies in Bangladesh

Many studies on accident were performed for different corridor in Bangladesh. But a comparative study on accident between more than single national highways are not too much available except the study of Elahi, (1986) on Dhaka-Mymensingh, Dhaka-Narayanganj and Dhaka-Chittagong national highway. This is probably due to limitation of summarized the accident data of same year interval for different highways. The literature review has revealed that the following studies were made on similar topic of accident and black spot study.

- Elahi, S.M (1986) in his MSc Engg. thesis in BUET analyzed the accidents on three selected national highways namely, Dhaka-Mymensingh, Dhaka-

Narayanganj and Dhaka-Chittagong highways. This analysis was done to find accident trend and severity. Twenty prone locations are on these highways were identified on frequency of accident occurrence. Detail topographic survey was carried on these locations. The study revealed that among the geometric aspects in adequate shoulder and pavement width are important causes of accidents. Findings of his analysis were average annual increase rate of accident is 14% during period of 1979 to 1984. Day time accidents are much higher than night time. During day time 74% accidents were occurred. Low accident rate has been observed in dry season. Then these studies provide some remedial improvements for these prone locations for reducing their accident rate.

- Sharmeen, (1996), in her MSc Engineering thesis in BUET upon truck involvement in road accidents in Metropolitan Dhaka revealed that about 32% accidents are fatal, 58% injuries, 9% property damage truck involve accidents. Accident occurred mostly in road link. Maximum of the accidents are rear end 29%, hit pedestrian 28% and head on 10%. A statistical quality control method employed to identified hazardous links. The vulnerable road users group is pedestrian 25.5%, followed by baby taxi 15.5%, rickshaw 15.1%. She also revealed in her study that nearly 15.5% of truck drivers were biased by alcohol.

- Hoque, (1991) conducted a comprehensive study on Dhaka-Aricha Highway. In total length 81.4 km, about 965 accidents out of these 419 fatal, 504 injuries, and 22 property damage only were recorded during the five year period 1985-1989. Data on accidents occurring on the highway and available to police during the aforesaid period were examined and characteristics of accidents were analyzed. The characteristics included relating to locations, road users' movements, vehicles and time of accident, accident rates, road site hazard and road casualties. Analysis reveals that each year there are at least 114 fatalities and 968 injuries, resulting in about 6 casualties per accident on this highway. Various low cost engineering treatments like shoulder improvements, delineation of guardrails, provision of overtaking lanes and improvements of deteriorating traffic lane and narrow bridge approaches were suggested by him.

- Hasan, (2007) in his M. Engineering thesis in BUET analyzed on involvement of vehicle factors in road accidents at Jamuna Multipurpose Bridge corridor, revealed that about 16.6% accidents happened due to vehicle defeat and casualty of this factor is 31.9%. Common vehicular faults due to accidents are tyre bursting which accounts 42.5% accident and 83.7% casualty of all vehicular defeat related accident which is followed by passenger fall down from roof top 7%, brake failure 5.7%, jam 2.6%, axle fallen 0.9% and defective light 0.1%. Questionnaire survey revealed that lack of vehicle fitness checking in field, poor vehicle maintenance practice, vehicle specification, overloading etc are identified as the major underlying causes of vehicular defeat related problem.

- Islam, (2004) in his MSc. Engg. thesis in BUET made another comprehensive study in accident black spot on Jamuna Multipurpose Bridge. He used the methodology to find the locations and level of clustering and non-clustering of accident events by using accident spot map and pin diagram. For analysis, collision diagram was prepared showing all accidents events in detail. From his analysis it was shown that about 64% accident occurred during day light but about 36% accidents are in darkness. On the other analysis about 62% accidents occurred in fine weather condition, 18% in rainy period and 20% in foggy condition. Then an economic analysis of accident was done in this study. Limitation of this study is the detail analysis for causes of accidents with remedial improvements of were not precisely described.

- Another study was conducted by Hoque, et al., (2005), on Dhaka-Aricha Highway. This study provides details on the improvement measures undertaken in three black-spot areas. In this study an attempt has been made to evaluate the effectiveness of safety improvement measures. Their effectiveness was evaluated by applying the "before-after" and "control-site" methods. Findings from the analyses suggest that safety improvement measures were very effective in reducing the frequency as well as the severity of accidents. In economic terms, this study is also estimated benefits from accident savings far outweighed the investment costs of safety improvements. The limitation of this study is, accident

analysis based on vehicle involved, severity index, period of action are not precisely described. In the selected black spot detail line diagram with location photograph is not discussed for safety improvements.

- Rafuzzaman, M. (2003) in M. Engineering thesis in BUET also conducted another study on characteristics of accidents on selected arterials of metropolitan Dhaka in terms of collision type, severity, modes used by the victims, weather condition etc revealed that in six years (1996 to 2001) 1847 no. of accidents occurred in his study five arterials in Metropolitan Dhaka city. The most predominal collision types are hit pedestrian 39.2% and rear end accidents 32.54%. Involvements of motorized vehicles are 77.96% and non motorized vehicles are 22.04%. Severity levels are fatal 37.09%, grievous 40.06%, simple 10.18% and collision only 13.22%. Overall 71.36% accidents were occurred in link and 28.64% accidents at intersections. About 98.48% accidents were occurred in fair weather condition and 1.52% in rainy condition. He also reveals in his study about 59.61% accidents occurred in day time. Then provide some remedial measures for reduction of accidents.

2.6 Overview

From the discussions made in this chapter, a brief idea on accident study, black spot monitoring methodology has been found. This chapter has elaborately discussed the basic related terms and definition related to this study, factors involve in accident, accident data records, criteria developed for black spot identification that have been very important in this research work. The black spot monitoring guideline provided with useful methodology which is helpful for vast investigation for further study.

This chapter also discussed about the previously performed studies in Bangladesh on related accident and black spot topics. It is revealed that there is a scope to make further comparative analysis of accident characteristics on three selected national highways and black spots on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways, since scarcity of data, time to work with.

CHAPTER-3

METHODOLOGY

3.1 Introduction:

An accident is generally defined as an event in which at least one motor-vehicle is involved, that occurred on a public road and which resulted in injury. This definition is used because in most countries computerized systems exist for the recording of such accidents. Accurate and comprehensive data is the main basis on which all road safety activities depends. An accident data system should establish on correct procedures for the collection, storage, analysis and dissemination of data for all traffic accidents. Contributing factors like road and traffic characteristics, vehicle parameters and information about the people involved in the accident have to be registered as well.

This chapter discussed about method adopted during corridor selection, data collection, sorting of raw data, make a comparative analysis on these corridors, selection of black spots, geographical and geometrical information of black spots with technical problems, average daily traffic (ADT) and observed vehicle speed measurement in a specific Dhaka-Sylhet national highway. But so far collected and preserved accident data from Accident Research Institute (ARI) and traffic flow data on Bangladesh-UK Friendship Bridge by the toll operators at Bhairab - Ashuganj on Dhaka-Sylhet national highway is providing a good opportunity for the transport planners to effectively utilize the data for accident and traffic flow analysis. Moreover, some other sources of short and long counts data have also been discovered during this study. Therefore, this study avails fair amount of quality accident data for comparing accident characteristics for selected three national highways and traffic data for traffic flow characteristics analysis and average observed speed of vehicle on Dhaka-Sylhet corridor in Bangladesh. This study also conducted comparative study among some selected node and site on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways.

3.2 Corridor Selection

Some of the major highway corridors in Bangladesh are-

1. Dhaka-Chittagong National Highway (N-1)
2. Dhaka-Sylhet National Highway (N-2)
3. Dhaka-North Bengal Corridor (N-5, N-6)
4. Dhaka-Aricha Road to South Bengal (N-5, N-7, N-8)

In this study three national highways are selected such as N-1, N-2 and N-5 for comparative accident analysis among them

In this study, Dhaka-Chittagong (N-1) National Highway is selected from km post 13, which starts Katchpur Bridge (Chittagong end) and ends to km post 270, at Rajakhali bazaar Bus Stand before Karnofuli Bridge.

Dhaka-Sylhet (N-2) National Highway is selected from km post 13, which starts Katchpur Bridge (Chittagong end) and end to km post 330, at Tetli Bus Stand, before Sylhet town.

And Dhaka –Aricha (N-5) National Highway is selected from km post 12, Amin Bazaar Bridge (Aricha end) and ends to km post 90, at Aricha Ghat, Shivaloy.

For accident black spot analysis on Dhaka-Sylhet National Highway, analysis in Km. post stationing is traditionally used for high accident frequency location identification such as black spot.

For selected segment due to comparative accident analysis among three national highways are shown marking red color in below the road network in Bangladesh

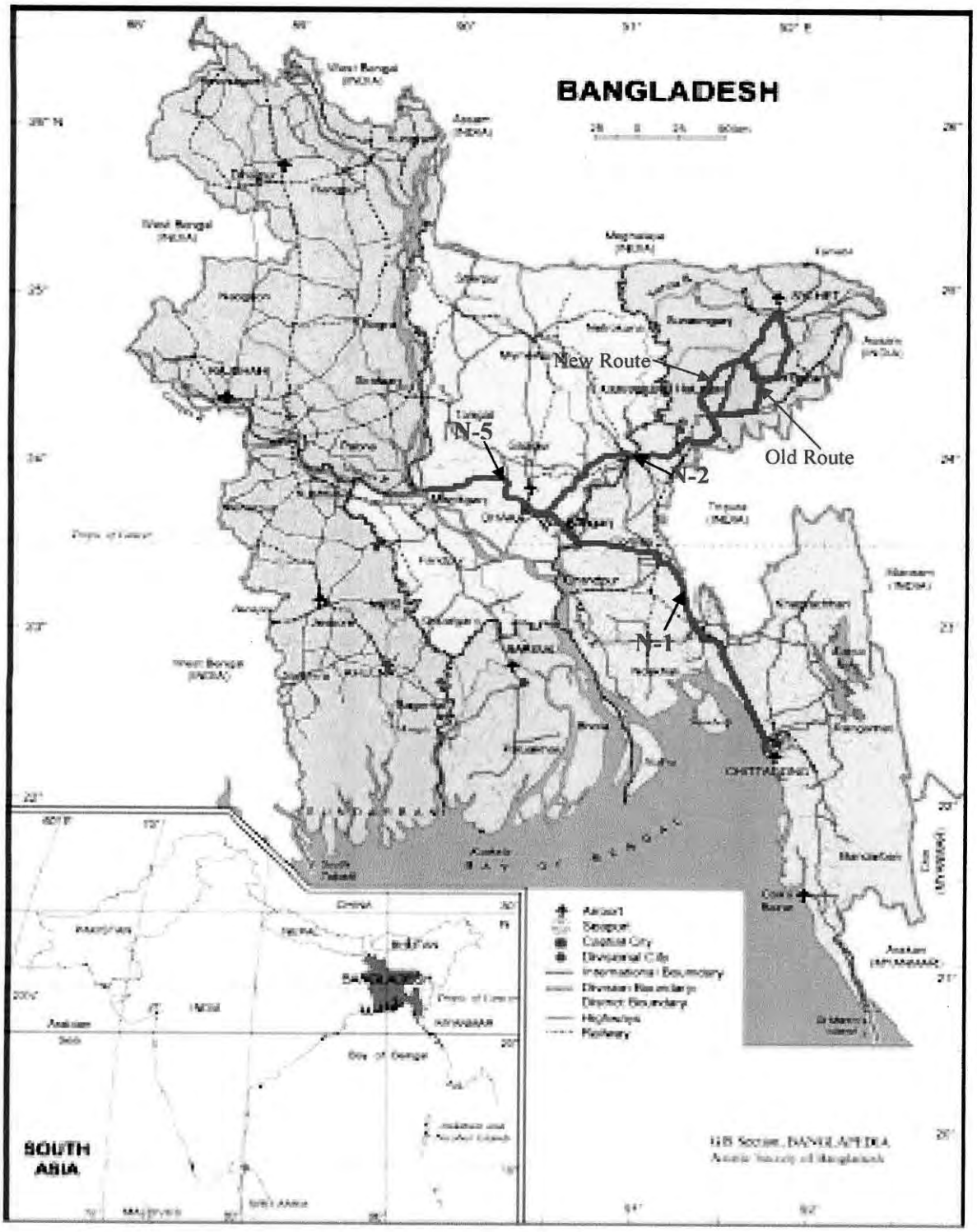


Figure 3.1: Map Showing National Highway Considered in the Study.

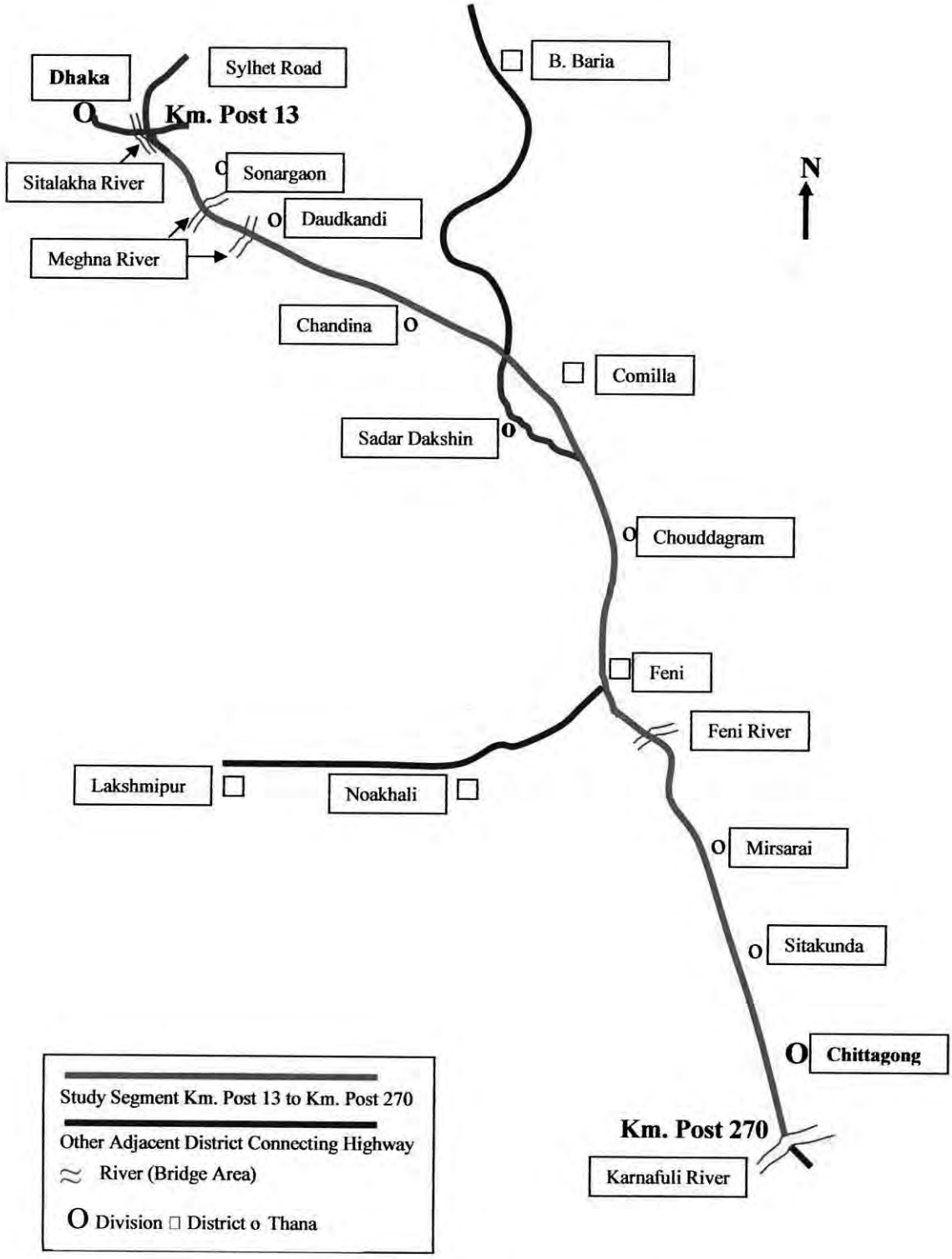


Figure 3.2: Dhaka Chittagong National Highway (N-1), [not in scale].

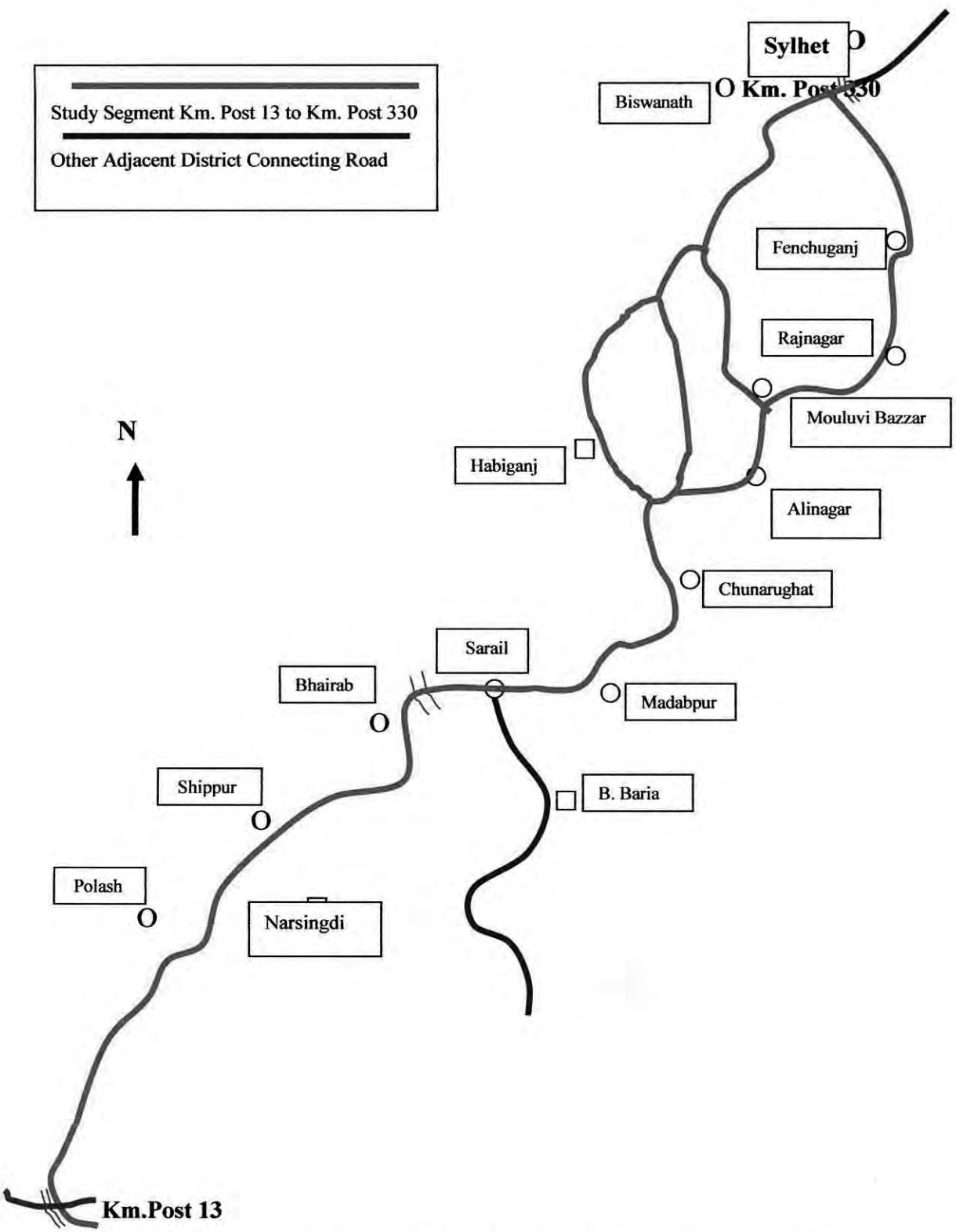


Figure 3.3: Dhaka - Sylhet National Highway (N-2), [not in scale].

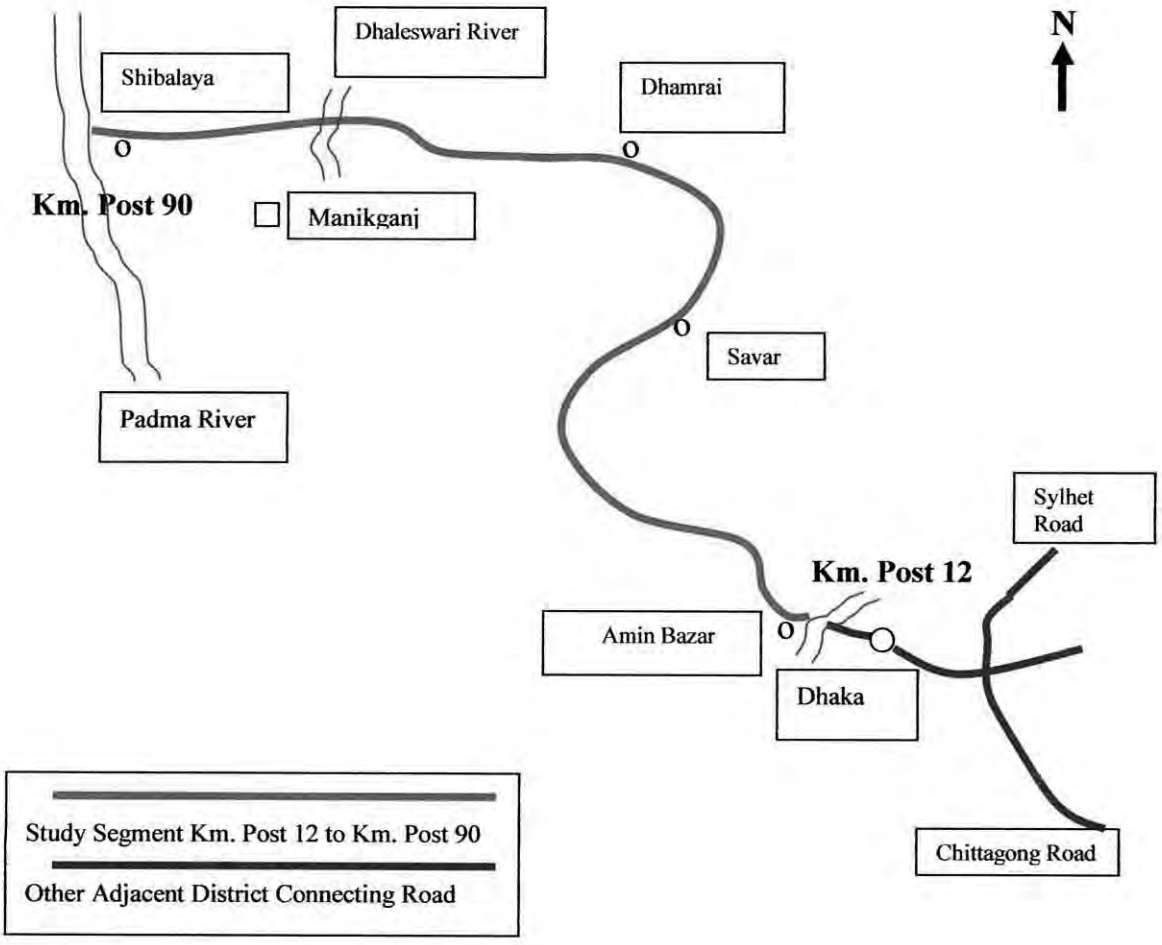


Figure 3.4: Dhaka - Aricha National Highway (N-5), [not in scale]

3.3 Data Item

Long term accident data is very important for any type of analysis. It is difficult to be accurate about the number of road accident as many accidents, including ones where people are injured, are not reported to the Police. Only those accidents with high injury or property damage or with disputes are reported and recorded in the police office. To effectively analyze, compare and make informed conclusions from the data it is necessary to fulfill these basic requirements of accidents which are accuracy (to exactly describe the

individual parameters), complexity (to include all features within the given system), availability (to be accessible to all users) and uniformity (to apply standard definitions). The last parameter (uniformity) is of vital importance for comparisons. There are different databases that often exist within one country. These databases may be managed by police, road administration, hospitals / health system and Insurance companies. Accuracy and magnitude of accident analysis depends on the availability of data on which it is based.

In Bangladesh recording of accidents with greater details started from 1977 by police, but due to lack of knowledge negligence in filling up the specified form and wide spread still it could not achieve the design goal. The main data used in this study for the evaluation of comparative accident study in the three national highways and black spot study on selected single national highway are as bellows:

- Yearly accident data based on severity of accident
- Yearly accident data based on damaged vehicle classes.
- Yearly accident data based on period of accident.
- Yearly accident data based on rural or urban area on study national highways.
- Yearly accident data based on casualty, severity, period on different study spot.

In this study, seven years accident data from year 2000 to 2006 were taken for comparative accident analysis on three national highways and three years data (2001 to 2003, 2004 to 2006) for black spots selection of specified corridor. All these data used for comparative accident analysis were collected from Accident Research Institute (ARI), BUET and traffic flow data, which was collected from Bhairab-Ashuganj toll plaza at Bangladesh-UK Friendship Bridge on Dhaka-Sylhet national highway.

3.3.1 Accident Data Reporting and Collection System in Bangladesh

An accident report form contains several information's for accident such as severity, period, date, road class, traffic control system, type of collision, road divider, environment, light condition, road geometry, classification and location of road etc. After a practical discussion with second officer, at Rupgonj Thana on Dhaka - Sylhet national

highway and another responsible person for accident data recording at Superintendent of Police office in Narayangonj district, it may be summarized that the following procedures are flowed in data record and collection for any study.

- In a police station, any road accident data is recorded as a First Information Report (FIR) form or in a general diary. Then recorded data related to accident information is entered into a khata named "Khatain Khata". A book is maintained for this job.
- The entry copy of FIR being attached with the application of "Ejher" made by the police officer or by the relatives of victim. After then, this report is send to the respective circle and Superintendent of police office.
- In the Circle and S.P office, crime index is prepared from the FIR according to month wise. Subsequent development in the process of enquiry is entered in both of the FIR book and crime index report book. FIRS are then sent to the court inspector and only crime index remains references.
- In each month consolidate accident reports form respective police stations are routed through circle and superintendent of police (S.P.) to deputy general inspector of police (DIG) of respective range.
- After that finally the data reached to the Assistant General Inspector (AIG) crime at the police head quarter.

All the accident data is entered in the Micro computer Analysis Package-5 software in the accident data unit (ADU) established in DIG office. This work is then forwarded to police head quarter, Assistant Inspector General (AIG) crime who is turn delivers it to road safety cell (RSC), who maintain national accident data base from 1977. For this above accident data should enter seriously with all other crimes and no separate sequence is maintained. In practice all road accident case are recorded in the FIR as Bangladesh panel code Dhaka-279, which expressed under following sections:

- Section 304 B – for fatal accident
- Section 338 A – for sever personal injury.
- Section 337 – for light personal injury.
- Section 427 – for property damage only.

At present, the entire accident report file is collected by Accident Research Institute (ARI), BUET, Dhaka-1000, for details processing, sorting, classification etc for different research purpose in Bangladesh.

3.3.2 Data Processing

Even the minimum set of data, enables the evaluation of the safety level of a road network, and the ability to discover a spot or section with a higher occurrence of accidents such as black spots. High-frequency accident occurrence locations (black spots) are emphasized as the first step of this study for road safety improvement programmes. Processing of raw data is a very important part of this study. For this study, after completion of detail check of these accident data by Accident Research Institute (ARI), the required data was then sorting, tabulated and proceed for detail comparative accident and black spot study.

The average daily traffic data (ADT) was collected from Bhairab-Ashuganj toll plaza in Bangladesh-UK Friendship Bridge. These data recording systems is totally computerized which were found that all data was recorded in three shifts in a day according to vehicle classification and after each month these daily total traffic flow summary sheet was sent to Roads and Highways Department. In summary sheet, the classification of vehicle was not done. For this, to evaluate average daily traffic, total traffic data according to vehicle class in each three shifts in a day for ten observed days were collected separately first, then detail sorting and tabulated of these data for best fit of study on ADT in selected Dhaka-Sylhet national highway. For observed vehicle speed measurement in a specified national highway, a section of 188'-0" was selected and time was counted for each vehicle class. After processing of these data of vehicle speed and completion of detail check, the summarized data is sorting in such a manner that the analyses works are best facilitated.

3.4 Development of Framework

One of the objectives of this study is to develop a framework through which the flowing Comparative analyses of accident among three corridors, black spots, average daily traffic study for particular corridor can be made.

- Corridor selection for make a comparative accident and black spot study.
- Collection of accident and average daily traffic flow data for this study from different data source.
- Summarizing accident data for severity, road users class, accident time, area etc.
- Diagnosis of these accident data for a comparative analysis among three highways.
- Selection of high accident frequency locations developing several black spot criteria.
- Summarizing accident data due to period based on total accident, road user class that involved in accident and casualty for selected spots.
- Detail geometrical and geographical investigation data of high accident locations.
- Collection of necessary photographs and find out probable causes of accident with remedial improvements of study black spots.
- Traffic composition in Dhaka-Sylhet national highway.
- Directional distribution analysis of average daily traffic.
- Field survey data of average vehicle speed in specified national highway.

The frame work should be such that, data collected form different organization and field surveys can be entered into the input worksheet and the formula is interlinked with the output charts and tables. In this study, Microsoft Excel compatible with MS Windows has been used for the purpose. However the latter method is recommended for future work.

3.4.1 Framework Flow Chart of This Study

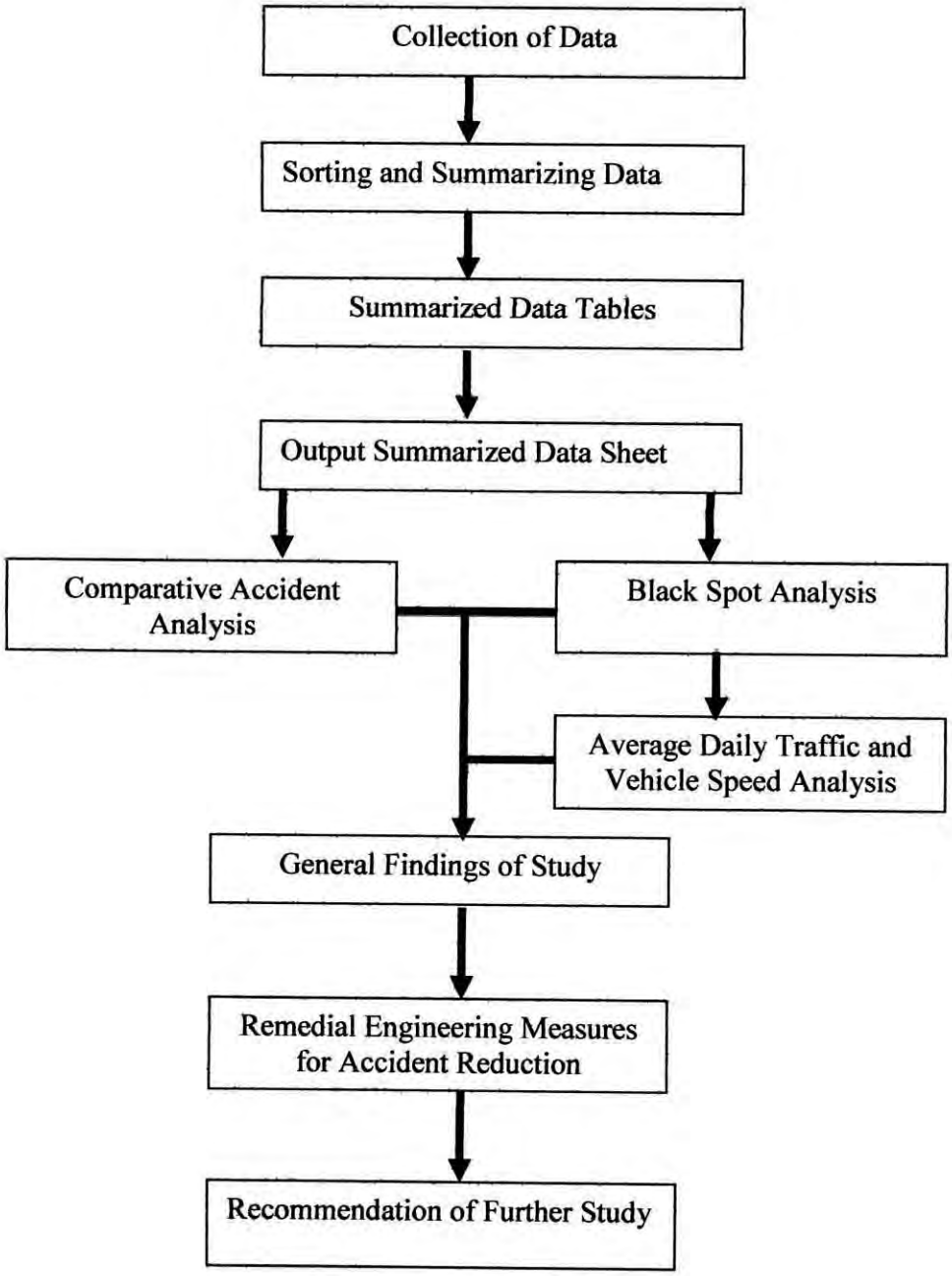


Figure 3.5: Flowchart of Frame Work Analysis

3.5 Overview

In this chapter, it is revealed the process of execution of this study. First three corridors are selected mentioning their start and end point with available road network map. This chapter also revealed the process of accident data collection from field and systems of reservation of these data when field visit during study. Further in this chapter a construction frame work is established for detail investigation of black spot, average daily traffic with vehicle speed which formulating the execution of this study work plan elaborately.

In the next chapter a comparative accident analysis among three corridors are made with available storage accident data.

CHAPTER-4

COMPARATIVE ACCIDENT ANALYSIS

4.1 Introduction

The major objectives of this study are to make a comparative accident analysis by using accidental data on the selected three important national highways of Bangladesh. The analysis is based on accident severity, accident involved vehicle class, period of accident and area of accident on highway. The scope of present study is limited because of sufficient accident data, information and accidents involving factors are not available. In this chapter, some figure has been prepared by using these available data for comparative study and make discussion accordingly. To fulfill this aspects, at first an accident analysis on the basis of accident based data for each highway is done separately. Than a comparative accident analysis is made among selected Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways of Bangladesh.

4.2 Accident Data Analysis

In these analyses, all accident data available are tabulated first for the three selected national highways such as Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha during period 2000 to 2006 accordingly. In this study, the analyses of the accident data maintain a sequence such as accident severity, accident involved vehicle class, accident period and area of accident on highway with detail analysis and discussion.

4.2.1 Accident Analysis on Dhaka-Chittagong National Highway

In this section detail accident investigations are done based on accident severity, accident involved vehicle class; period of accident and area of accident on this national highway is described detail below.

Table 4.1: Accident Severity on Dhaka-Chittagong National Highway

Year	Fatal	Grievous	Simple	Collision	Total
2000	35	11	10	1	57
2001	14	11	2	3	30
2002	60	23	12	4	99
2003	26	4	7	3	40
2004	127	38	18	8	191
2005	119	28	10	8	165
2006	124	22	5	1	152
Total	505	137	64	28	734

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

It is observed that before year 2004 the total accident frequency on this national highway is comparatively little with respect to the recent years. The number of accident in four full calendar years (2000 to 2003) is 226 but in last three years (2004 to 2006) it becomes 508, which means that it is increased 2.3 times more. Accident fatality is also considerably maximum with respect to total accidents which are about 68% than follows by grievous 19%, simple 9% and collision type of accidents are 4% observed in figure 4.2.

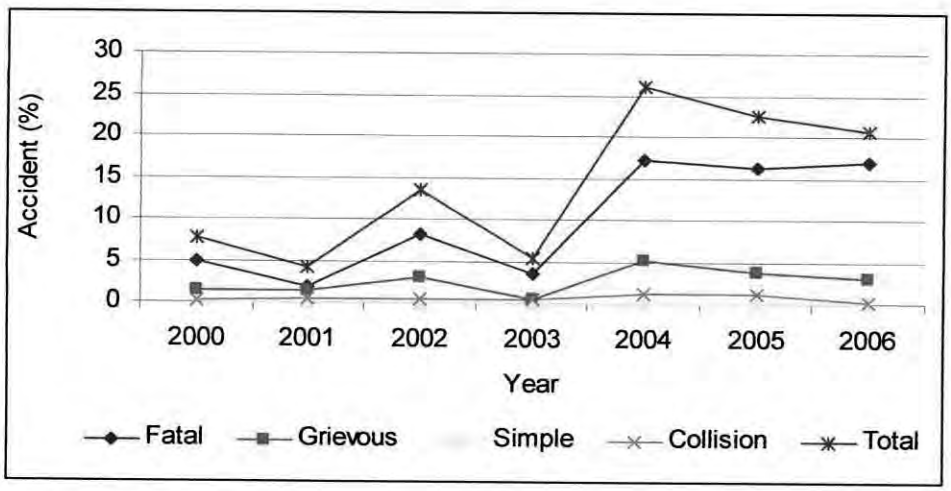


Figure 4.1: Yearly Accident Severity on Dhaka-Chittagong Highway.

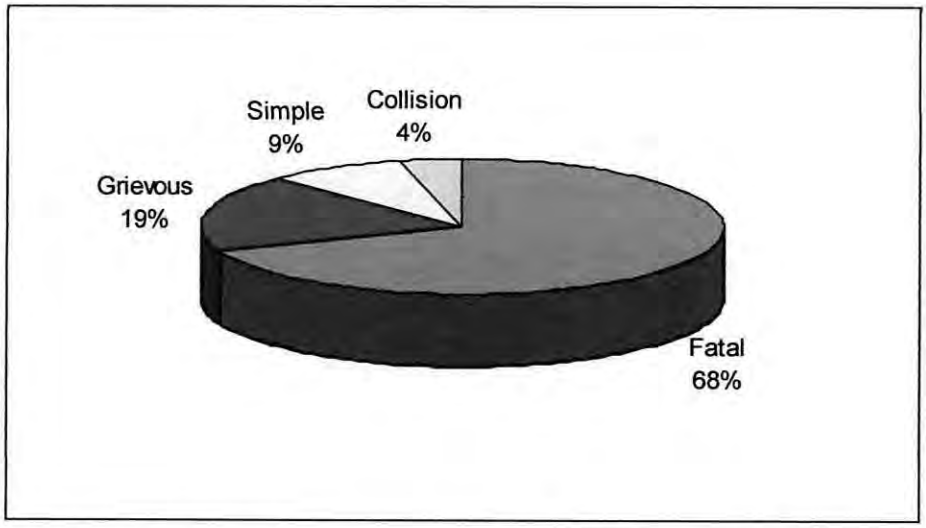


Figure 4.2: Accident Severity on Dhaka-Chittagong Highway

It is also observed in figure 4.1 that, during last seven years, fatal accidents are dominated allover other types of accidents. Fatal accident in year 2000 is 35 but after seven years it is increased 124 which are about 3.6 times more. Grievous types of accident as second dominating accident types which has also a significance effect on this highway and also increased after year 2004 with respect the past years. Simple and collision types of accident occurred in this highway relatively identical during the study period.

Table 4.2: Accident Involved Vehicle Class on Dhaka-Chittagong Highway

User Class	2000	2001	2002	2003	2004	2005	2006	Total
Large Bus	30	10	31	17	88	61	60	297
Small Bus	7	4	21	9	24	42	14	111
Truck	39	22	65	22	104	75	74	401
Car	10	4	8	6	36	24	24	112
Others	1	0	8	5	31	26	21	92
Total	87	40	133	59	283	218	193	1013

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

This analysis exposed that maximum vehicles involvement in accident is considerably high after year 2004. In year 2004, vehicles involved due to accident on this national highway are about 28% of total accident involved vehicles during study seven years.

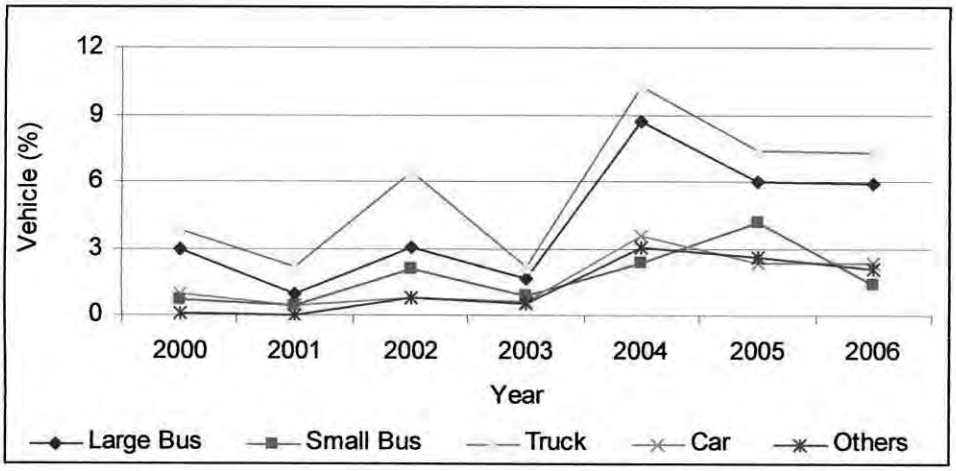


Figure 4.3: Yearly Accident Involved Vehicle on Dhaka-Chittagong Highway.

From the analysis of accident involved road vehicles in figure 4.4, it is observed that the maximum accident responsible vehicle class is truck on this selected highway which is about 40% of total accident involved damaged vehicle during this study period and followed by large bus, small bus and car which is 29%, 11% and 11% respectively.

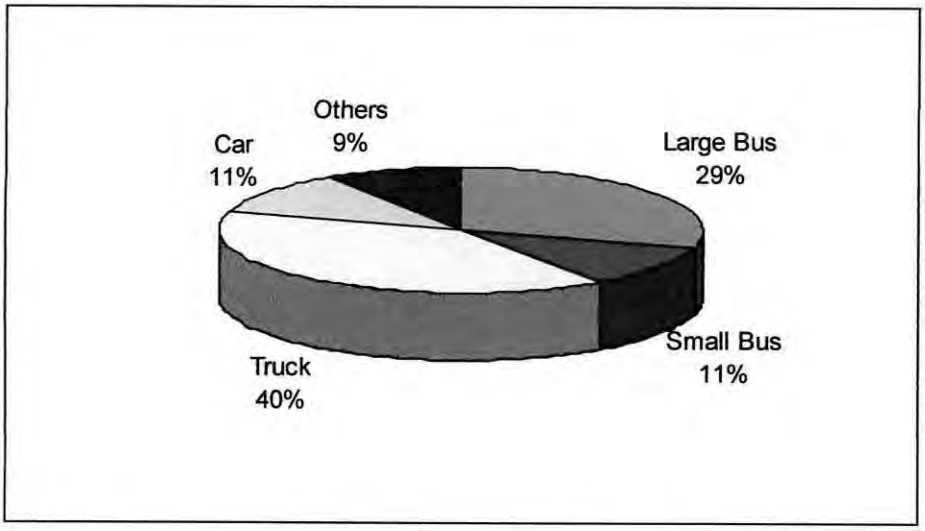


Figure 4.4: Accident Involved Vehicle on Dhaka-Chittagong Highway

In the temporal distribution of accident involved vehicle due to accident in figure 4.3 it is also exposed that vehicle involvement due to accident is fluctuated through out the study period. In the recent year vehicle involvement is quite objectionable. Truck the road vehicle class is always responsible for maximum road accident in every year. Involvements of road vehicle classes due to accident are significantly increased during the recent years. The minimum accident occurred for all road vehicle classes in year 2001 on this national highway. Other accident involved vehicle class such as cycle rickshaw, push cart, motor cycle, tempo, artic, oil truck, tractor and animal due to accident is almost same during this study period is about 9% only of total accident involved vehicle which is considerably bare minimum. From the analysis in figure 4.3 it is also revealed that the yearly variations of accident involved vehicle classes are fluctuated throughout the study period. It is also found that before period 2003, the vehicle classes' involvement is minimum but it significantly increased after period 2003.

Table 4.3: Accident Based on Period Dhaka-Chittagong Highway

Time	2000	2001	2002	2003	2004	2005	2006	Total
12.00A.M-1.59 A.M	1	3	6	0	9	21	13	53
2.00A.M-3.59 A.M	1	4	6	1	14	9	8	43
4.00A.M-5.59 A.M	3	6	4	5	13	18	18	67
6.00A.M-7.59 A.M	2	3	10	2	20	21	18	76
8.00A.M-9.59 A.M	7	2	14	6	17	14	13	73
10.00A.M-11.59 A.M	6	1	17	2	22	22	17	87
12.00P.M-13.59 P.M	7	2	11	5	25	12	19	81
14.00P.M-15.59 P.M	11	2	8	4	11	11	13	60
16.00P.M-17.59 P.M	7	3	13	6	18	7	13	67
18.00P.M-19.59 P.M	5	0	2	3	17	11	6	44
20.00P.M-21.59 P.M	7	2	4	6	13	12	4	48
22.00P.M-23.59 P.M	0	2	4	0	10	7	5	28
Total (24 hours)	57	30	99	40	189	165	147	727

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

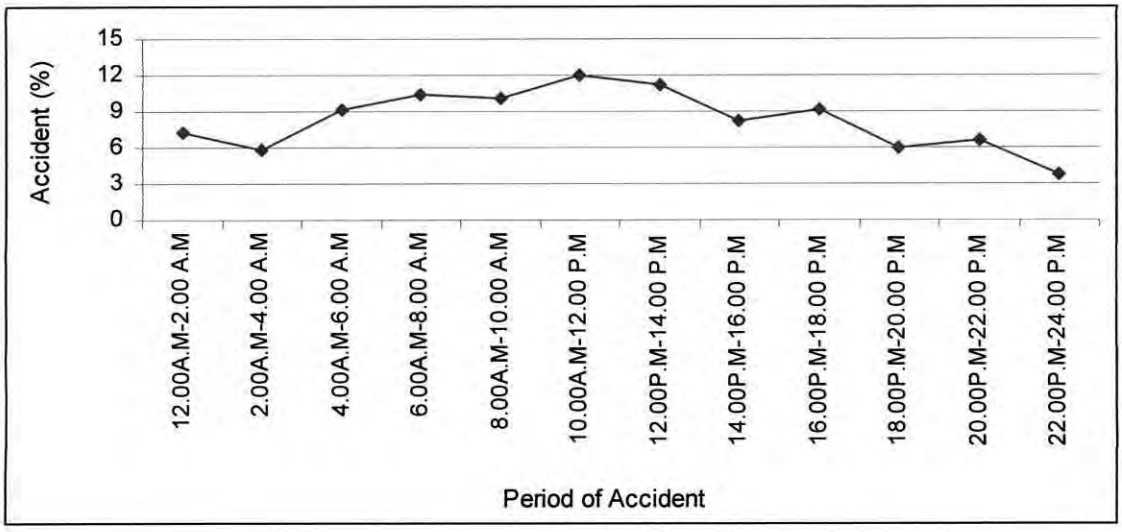


Figure 4.5: Accident Period on Dhaka-Chittagong Highway.

From the analysis of accident distribution in figure 4.5, it is observed that on Dhaka-Chittagong national highway during this seven years study period, maximum accidents are dominated during 10.00 A.M to 12.00 P.M which is about 12%. Generally more accidents are occurred in between time 6.00A.M to 14.00 P.M and this is about 44% of total accident occurred on this national highway. Considerably low accidents are observed in other periods on this vital busy national highway of Bangladesh.

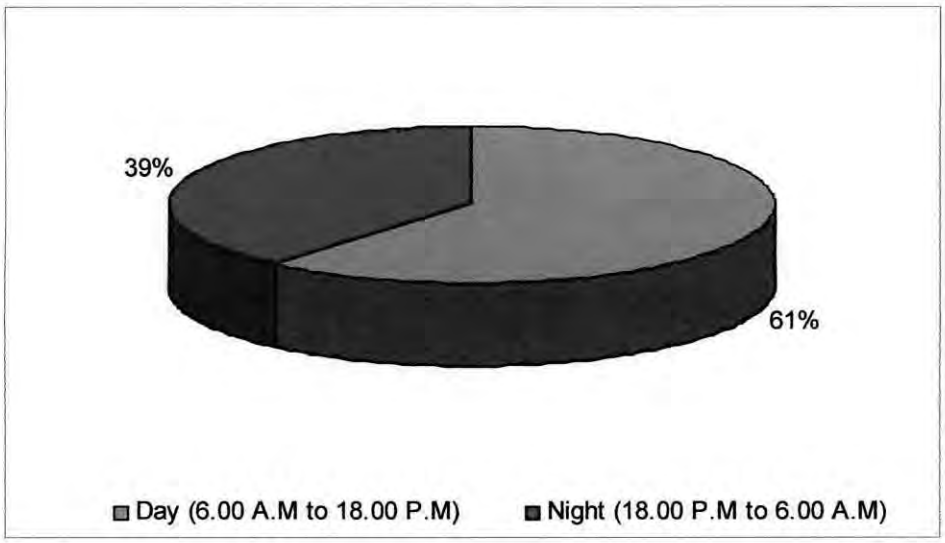


Figure 4.6: Accident over Day and Night on Dhaka-Chittagong Highway

From figure 4.6, the analysis is conducted for the percentage of accident during day as well as night time and observed that majority numbers of accidents are occurred during day time over night. The last seven years study period from 2000 to 2006, it is bring into being that, on an average in Dhaka – Chittagong national highway around 61% accidents are occurred by day time in comparing to night which are only 39%. From this it can be taken a result that day time journey is more risky than night time on Dhaka-Chittagong national highway based on analysis data.

Table 4.4: Accident Based on Area in Dhaka-Chittagong National Highway

Year	Urban	Rural	Total
2000	7	50	57
2001	1	29	30
2002	4	95	99
2003	2	38	40
2004	26	164	190
2005	22	139	161
2006	18	129	147
Total	80	644	724

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

From the analysis of data table 4.4, it is again revealed that during study period 2000 to 2006 on Dhaka-Chittagong national highway most of the accidents are occurred in rural areas than urban areas. Accidents in rural areas are almost eight times more than urban areas which are too much higher scale on this national highway. It is also observed that in year 2000, the accident in urban and rural area is comparatively low but after seven years these accidents frequency increased around 2.6 times which is considerably very high.

More accidents are occurred in year 2004 is 190 and out of which only 14% accidents are occurred in urban areas and rest 86% accidents are occurred in rural areas.

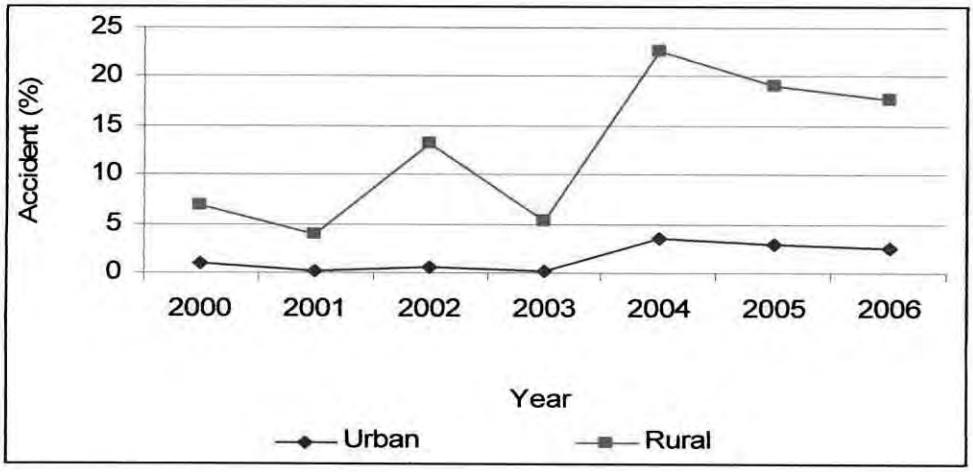


Figure 4.7: Yearly Accident Distribution Area on Dhaka-Chittagong Highway

From figure 4.7, it is observed that accident distribution in rural area is always elevated scale through out study period over urban area. After year 2003, accident frequencies on both urban and rural area are increased considerably and these are very higher scale for rural areas which are about 60% of total accidents.

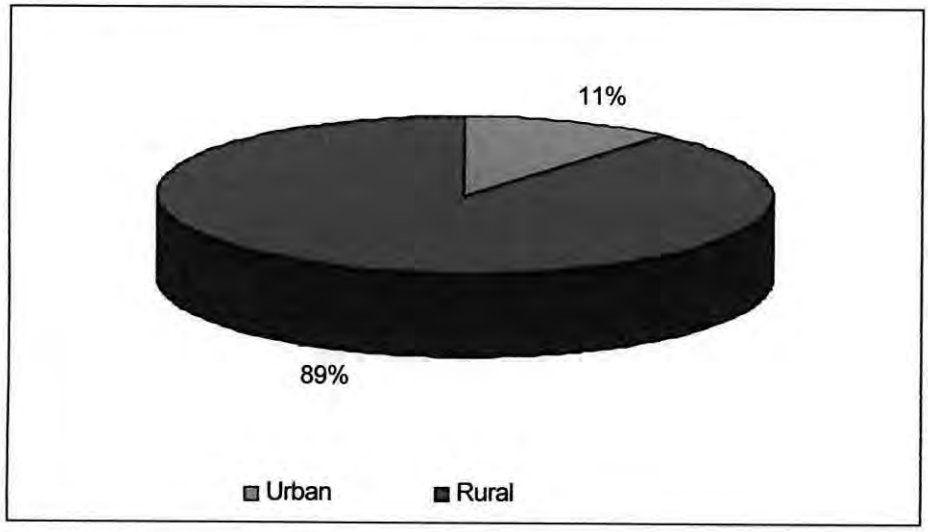


Figure 4.8: Accident Frequency Area on Dhaka-Chittagong Highway.

After analysis of figure 4.8, it is revealed that in urban areas accidents contribution are around 11% and in rural areas is 89% which is eight times more than urban areas. This may be excessive speed of motorized vehicle in rural areas with respect to urban areas.

4.2.2 Accident Analysis on Dhaka-Sylhet National Highway

Table 4.5: Accident Severity on Dhaka-Sylhet National Highway

Year	Fatal	Grievous	Simple	Collision	Total
2000	78	22	7	3	110
2001	62	20	7	0	89
2002	44	16	4	0	64
2003	24	15	1	0	40
2004	46	8	0	1	55
2005	35	4	2	0	41
2006	65	19	1	2	87
Total	354	104	22	6	486

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

It is observed from figure 4.9 that in before year 2003 the total accident frequency on this national highway is comparatively high with respect to the recent years. The number of accident in four calendar years (2000 to 2003) is 303 but in last three years (2004 to 2006) it becomes 183, which is decreased 0.6 times. Accident fatality is also considerably maximum with respect to total accidents which are about 73% than follows by grievous 21%, simple 5% and collision type of total accidents.

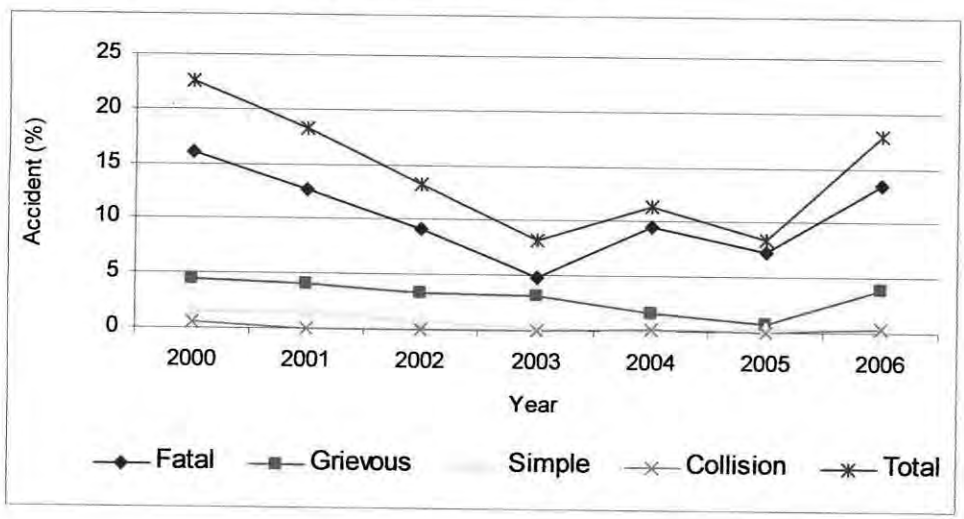


Figure 4.9: Yearly Accident Severity on Dhaka-Sylhet Highway.

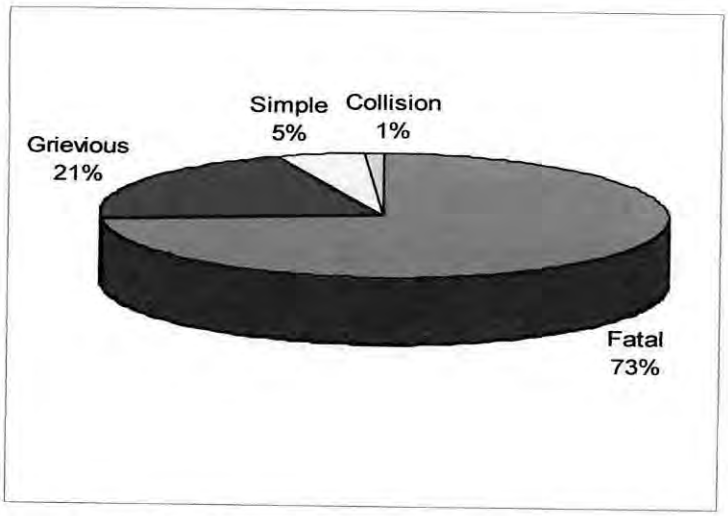


Figure 4.10: Accident Severity on Dhaka-Sylhet Highway

From the analysis of graphical distribution for accidents severity types on Dhaka-Sylhet national highway in figure 4.10, it is observed that fatal accidents 73% are dominated all over the study period than other types of accident. In past the accident severities are too much high on this national highway and it is gradually decreased up to year 2003, but after this year it is observed that severity of accident is again start to increase and it is too more than last study year. Comparatively grievous accidents are second dominating accident severity on this national highway. It is comparatively low with respect to fatal accident type. Simple and collision type of accident have less effect on this highway.

Table 4.6: Accident Vehicle Class on Dhaka-Sylhet National Highway

User Class	2000	2001	2002	2003	2004	2005	2006	Total
L. Bus	46	31	29	15	22	15	43	201
S. Bus	26	18	15	13	15	7	10	104
Truck	40	35	29	12	20	11	30	177
Car	9	6	6	3	3	3	12	42
Others	21	26	12	14	20	12	8	113
Total	142	116	91	57	80	48	103	637

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

From analysis in figure 4.11, it is revealed that road vehicle class involvement due to accident is considerably decreased in the recent years over past study years. It is observed that in year 2000 the total road vehicle class involved in accident is about 142 and after year 2006 is about 103 which are decreased by around 0.73 times. More over other study year these road vehicle class involvement due to accidents are also considerably low.

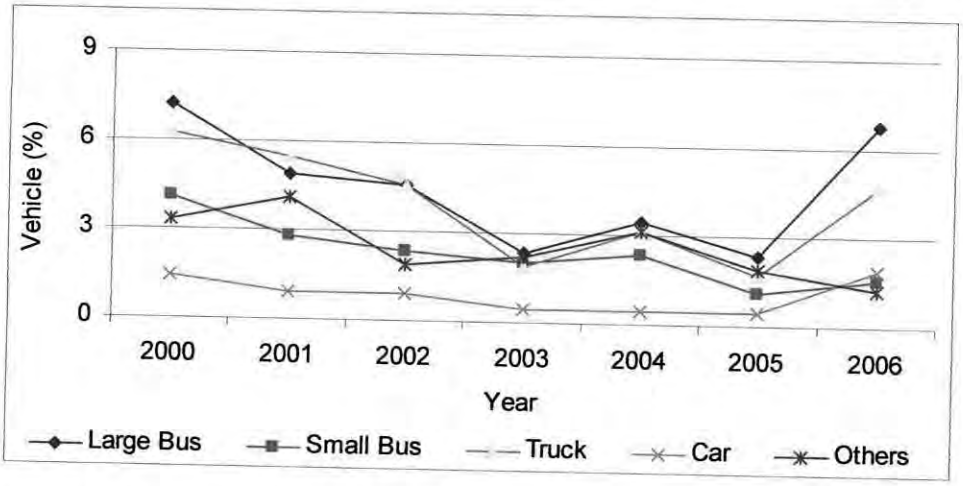


Figure 4.11: Yearly Accident Involved Vehicle on Dhaka-Sylhet Highway

From the road vehicle class temporal distribution in figure 4.11, it is clearly observed that before year 2003 total accident involved vehicle is 64% of total vehicle class which is comparatively very high. From the analysis, it is also observed that the maximum responsible vehicle classes are large bus and truck for accident on this national highway.

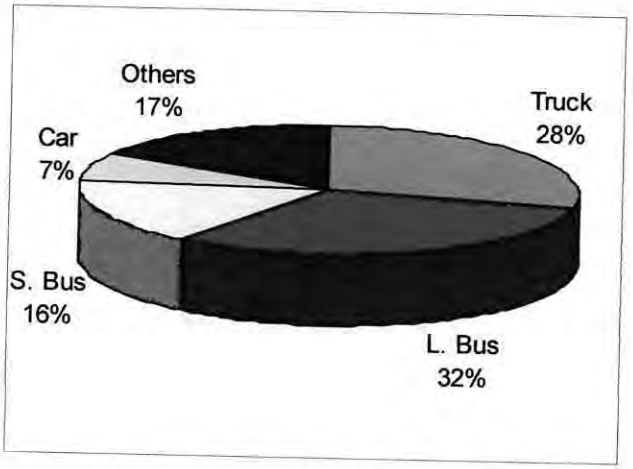


Figure 4.12: Accident Involved Vehicle on Dhaka-Sylhet Highway

Minimum accident due to bus and truck with other vehicles are occurred in the year 2003. Before year 2003, the involvement of bus and trucks has more effect for accident on this national highway. On the other hand the accident occurred by car has significantly lower effect comparing other vehicle class on this national highway. But in the last study year 2006, it is found that accidents due to bus and trucks as well as other vehicle classes are increased again significantly. It is also revealed that yearly variation of accident involved vehicle classes is little in year 2005. From figure 4.12 it is again revealed that maximum accident involved vehicle classes are large bus is about 32% and truck is about 28% after then followed by small bus16%. Other damaged vehicle classes such as cycle rickshaw, push cart, motor cycle, tempo, artic, oil truck, tractor and animal due to accident has also a significance affect is 18% of total accident involved vehicle on this national highway.

Table 4.7: Accident Based on Period Dhaka-Sylhet National Highway

Time	2000	2001	2002	2003	2004	2005	2006	Total
12.00A.M-1.59 A.M	3	3	2	1	3	3	2	17
2.00A.M-3.59 A.M	3	0	1	0	5	2	0	11
4.00A.M-5.59 A.M	6	3	2	2	2	0	9	24
6.00A.M-7.59 A.M	8	7	4	2	6	4	9	40
8.00A.M-9.59 A.M	11	10	3	1	2	2	8	37
10.00 A.M-11.59 A.M	15	10	11	8	7	8	6	65
12.00P.M-13.59 P.M	16	14	11	2	8	3	11	65
14.00P.M-15.59 P.M	17	13	6	5	6	5	17	69
16.00P.M-17.59 P.M	18	14	11	11	7	7	11	79
18.00P.M-19.59 P.M	2	5	6	6	4	5	4	32
20.00P.M-21.59 P.M	4	4	3	0	3	1	4	19
22.00P.M-23.59 P.M	7	5	4	2	2	1	4	25
Total (24 hours)	110	88	64	40	55	41	85	483

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

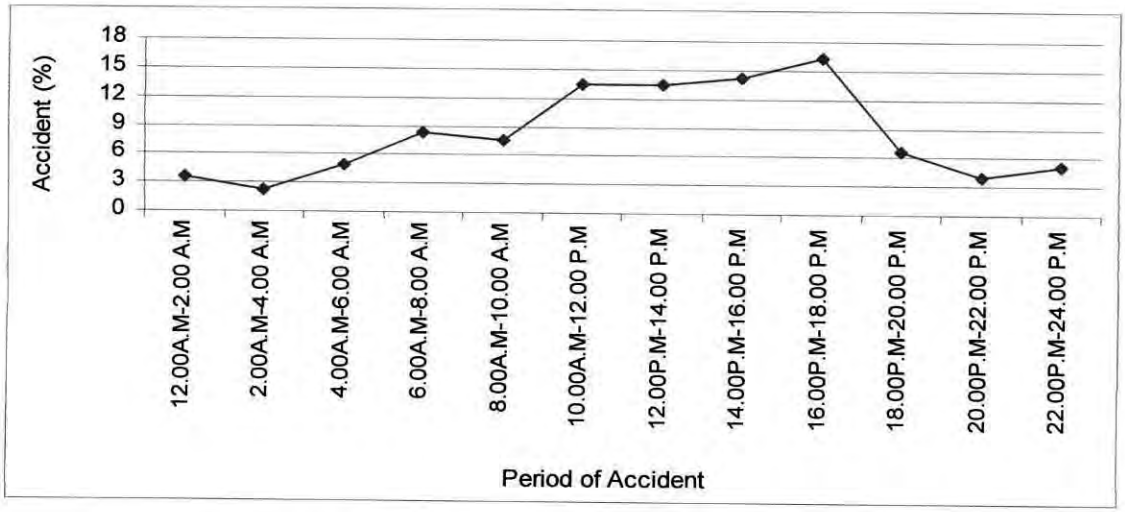


Figure 4.13: Accident Period on Dhaka-Sylhet Highway.

From the analysis of accident distribution in figure 4.13, it is observed that on Dhaka-Sylhet national highway during the study period, maximum accidents are dominated in between 10.00 A.M to 18.00 P.M which is about 58%. Generally more accidents are occurred in time 16.00P.M to 18.00 P.M which is about 16% of total accident occurred on this national highway. Considerably low accident frequency is observed in other periods on this study highway. The accident frequency are started to increase after 4.00 AM and again start to drop after period 18.00 P.M. The safer period on this national highway is in between 2.00 A.M to 4.00 A.M based on the data analysis.

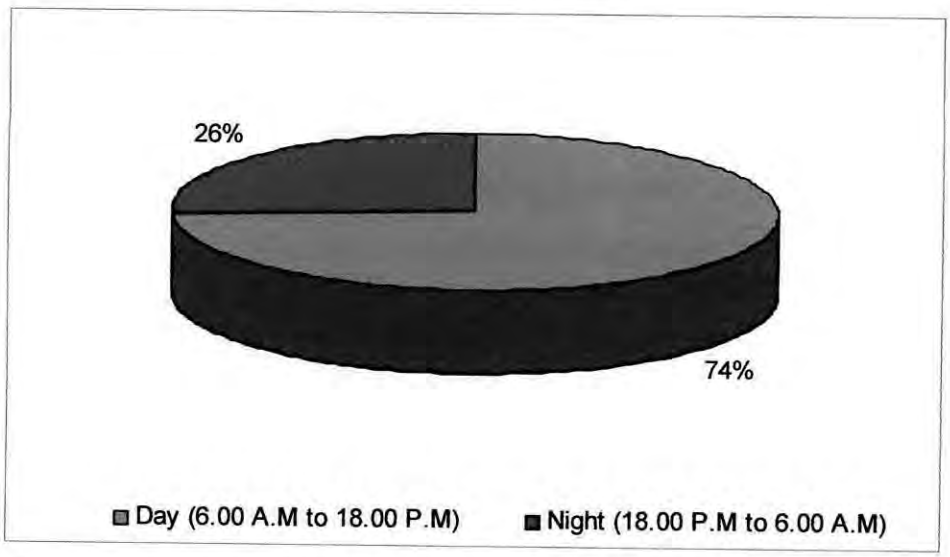


Figure 4.14: Accident over Day and Night on Dhaka-Sylhet Highway

Analysis of percentage for accident during day as well as night time, are done separately in figure 4.14 and observed that majority of accidents are occurred during day time over night. After the last seven years study period's (2000 to 2006) accident data analysis, it is observed that, on an average on Dhaka – Sylhet national highway around 74% accidents are occurred by day time in comparing to night which are only 27%. From this it can be taken a result that day time journey is more risky over night time on Dhaka-Sylhet national highway based on above analysis data.

Table 4.8: Accident on Area in Dhaka-Sylhet National Highway

Year	Urban	Rural	Total
2000	21	88	109
2001	13	76	89
2002	8	55	63
2003	7	32	39
2004	6	46	52
2005	1	38	39
2006	1	86	87
Total	57	421	478

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

From the analysis of data table 4.8, it is revealed that during in study period on Dhaka-Sylhet national highway most of the accidents are occurred in rural areas over urban areas. Accidents in urban areas are too much small scale with respect to rural area. It is also observed that in year 2000, the accident in urban and rural area is comparatively more but after seven years on this national highway, this accident frequency are decreased around 0.80 times which is considerably minimum.

More accidents are occurred in year 2000 is about 109. Out of which only 19% accidents are occurred in urban areas and rest 81% accidents are occurred in rural areas during this maximum accident year.

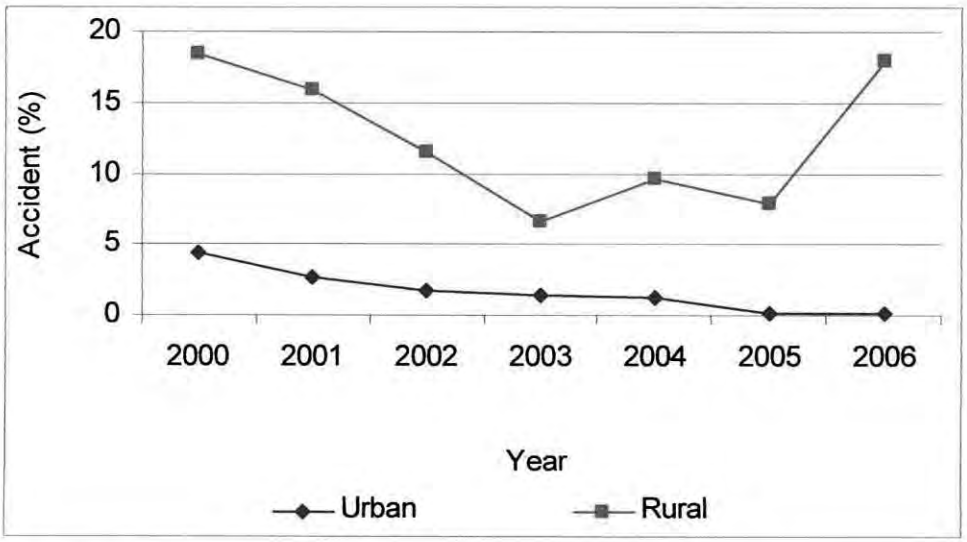


Figure 4.15: Yearly Accident Distribution Area on Dhaka-Sylhet Highway

From figure 4.15, it is observed that accident rate in rural area is always higher scale through out study period over urban area. Before year 2003, accident frequency on both urban and rural areas is considerably more. But in recent year though accident frequency is minimum in urban areas, it is very higher scale of total accidents in rural areas on this national highway. The minimum accidents are occurred in year 2003 is about 8% and maximum accidents are occurred in year 2000 which was around 23% of total accident on this national highway. Accident frequency is also more for last study year is about 18%.

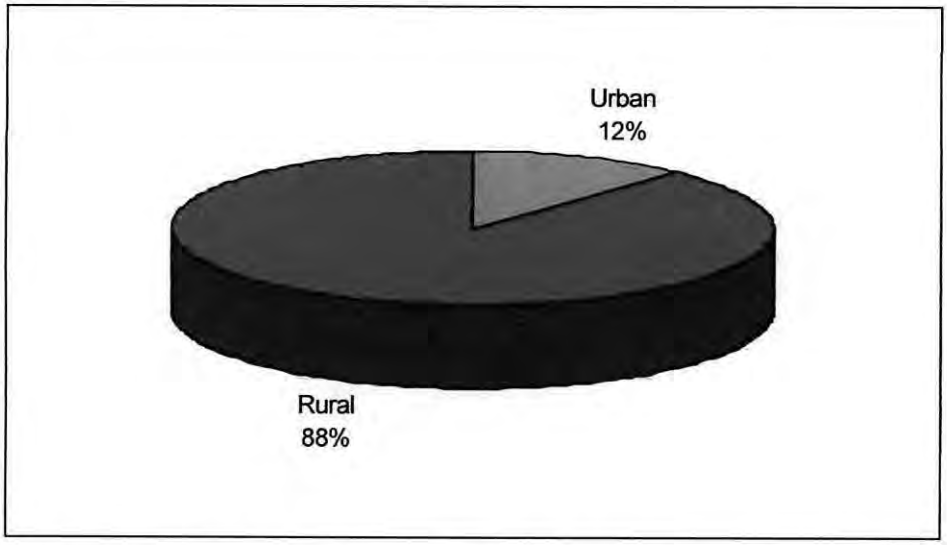


Figure 4.16: Accident Area on Dhaka-Sylhet National Highway.

On this national highway, in year 2000 the trend of accidents is gradually decreased up to year 2003. After this year accident trend again start to increase up to last study period 2006. In year 2003, the accidents frequency in rural area is considerably decreased. It is also shown that in recent two years almost all accident is occurred in rural area over urban area on this selected national highway. From figure 4.16, it is also revealed that only around 12% accidents are occurred in urban area and about 88% accidents are occurred in rural areas which are around 7.5 times of urban accidents frequency.

4.2.3 Accident Analysis on Dhaka-Aricha National Highway

Table 4.9: Accident Severity on Dhaka-Aricha Highway

Year	Fatal	Grievous	Simple	Collision	Total
2000	51	18	2	0	71
2001	38	14	4	3	59
2002	25	15	4	0	44
2003	37	21	0	4	62
2004	20	6	2	1	29
2005	64	22	1	2	89
2006	34	16	2	4	56
Total	269	112	15	14	410

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

It is observed from table 4.9 that before year 2004 the total accident frequency on this national highway was comparatively low with respect to other study years. Maximum accidents are fatal type which is about 269 and than followed by grievous, simple and collision types of accident. Accident fatality is fluctuated all over the study year which is comparatively large scale. In year 2004, accidents are occurred on this highway is lower scale over other study period. It is also observed that simple and collision types of accident frequency are minor influence on this selected national highway.

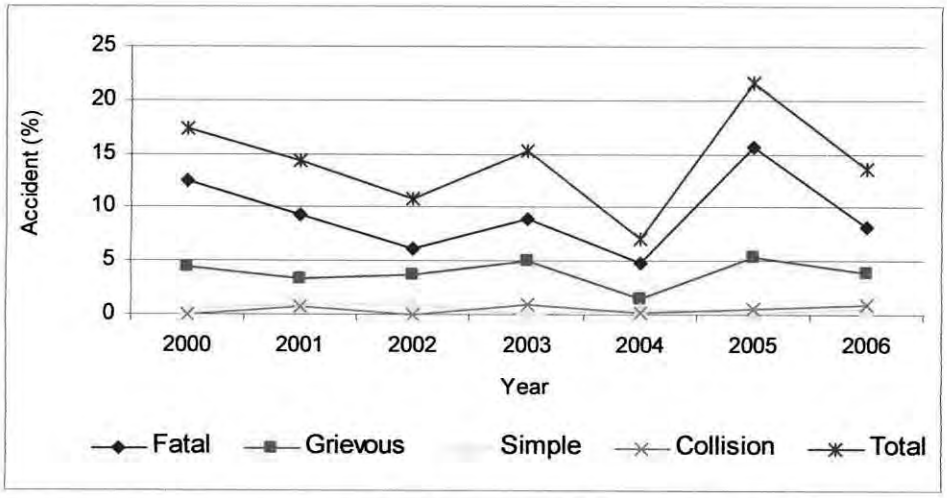


Figure 4.17: Yearly Accident Severity on Dhaka-Aricha Highway

From the temporal distribution of accident severity in figure 4.17, it is clearly observed that accident severity is fluctuated all over the study period. Fatal accidents are dominating on this national highway in every year. Before year 2003, accident is about 42% of total accident which is distributed in similar manner of year.

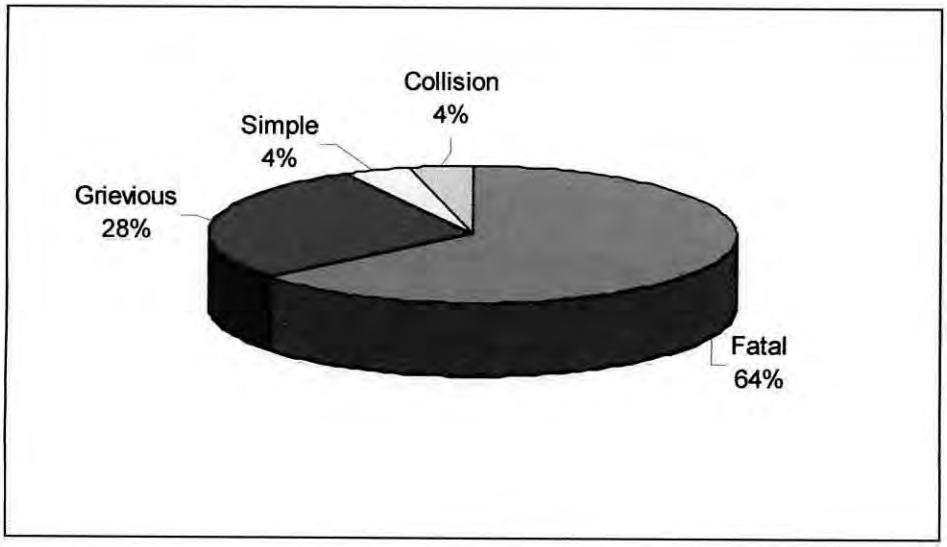


Figure 4.18: Accident Severity on Dhaka-Aricha National Highway

From the analysis of accidents severity types on Dhaka-Aricha national highway from figure 4.18 it is observed that fatal accidents 64% are dominated all over the study period than other types of accident. In past the accident severities are too much high on this highway and it is gradually decreased up to year 2004, but in the recent years it is again started to increase and too more. Comparatively grievous type accidents are subsequent dominating severity on this national highway but it is comparatively low influence with respect to fatal accident type and relatively less fluctuated over the change of years. Fatal accidents are almost 2.3 times more than grievous types of accident on this selected national highway. Simple and collision type of accident have less effect on Dhaka-Aricha national highway.

Table 4.10: Accident Involved Vehicle Class on Dhaka-Aricha Highway

User Class	2000	2001	2002	2003	2004	2005	2006	Total
L. Bus	38	25	19	34	15	45	35	211
S. Bus	12	6	13	12	7	5	10	60
Truck	31	30	20	21	15	29	16	162
Car	5	7	4	9	3	8	6	42
Others	13	5	10	12	3	17	9	74
Total	99	73	66	88	43	104	76	549

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

From the analysis in table 4.10, it is observed that the maximum responsible road vehicle classes are large bus and truck for accident on this highway. Accident involved road vehicle classes are fluctuated over the study period and it is minimum in year 2004 which are only 8% and maximum in year 2005 which are 19% of total vehicle classes. Maximum accident involved road vehicle classes are large bus and than flowed by truck. From another vehicle class distribution in figure 4.19, it is observed that large buses are actively involved and fluctuated with other road vehicle classes through the study period and than secondly followed by truck. Accident due to small bus and truck with other vehicles (cycle, rickshaw, push car, motor cycle, tempo, artic, oil truck, tractor and animal)

occurred in this highway is almost close with each other. In the recent year's road vehicle class involvement due to accident are quite objectionable.

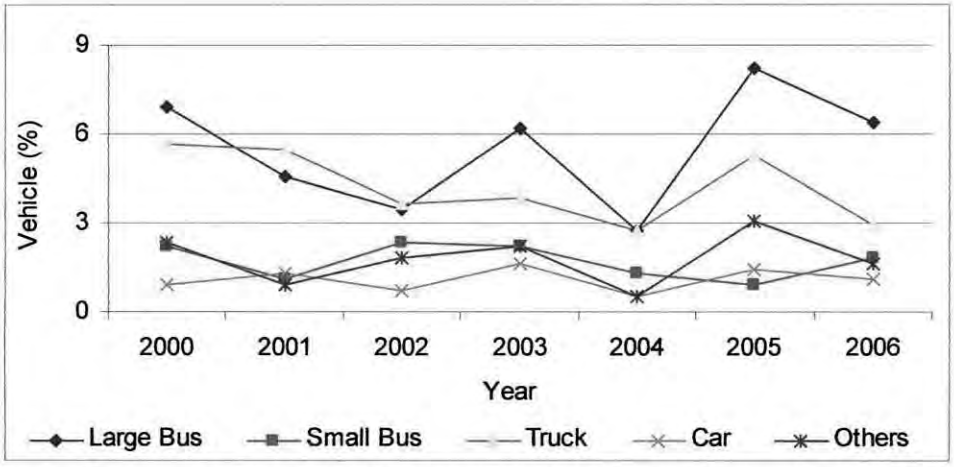


Figure 4.19: Accident Involved Vehicle Distribution on Dhaka-Aricha Highway

From the analysis in the figure 4.20, large buses are the important road vehicle class which is always responsible for maximum road accident and it is found that around 38% of total road vehicles classes are large bus. Then second accident involved vehicle classes are truck, which is 30% of total accident involved vehicle class on this selected highway.

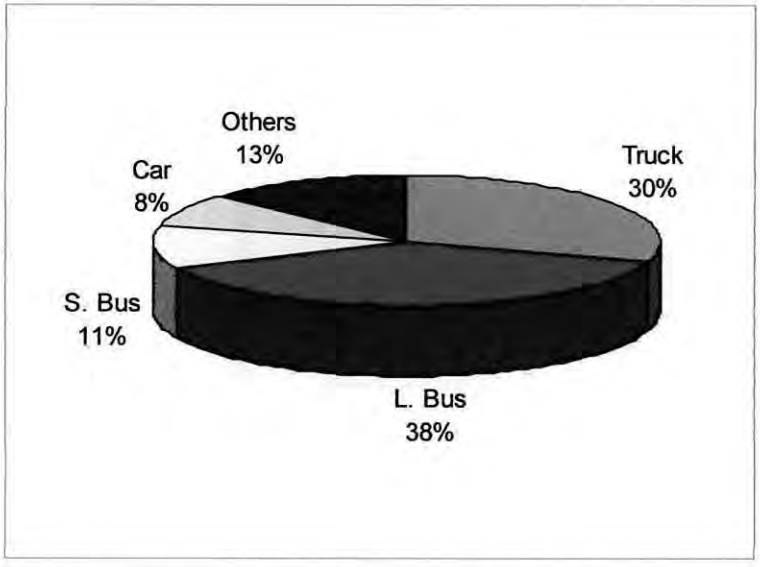


Figure 4.20: Accident Involved Vehicle on Dhaka-Aricha Highway

The frequency of involvement of large bus is around 1.3 times over truck in accident on this national highway. Other accident involved road vehicle classes such as cycle rickshaw, push cart, motor cycle, tempo, artic, oil truck, tractor and animal due to accident is almost same in this study period and about 13% of total accident involved vehicles which is considerably minimum. Accident due to car 8% and small bus 11% has also significant effect on this selected national highway.

Table 4.11: Accident Based on Period in Dhaka-Aricha National Highway

Time	2000	2001	2002	2003	2004	2005	2006	Total
12.00A.M-1.59 A.M	2	0	0	3	2	5	2	14
2.00A.M-3.59 A.M	1	1	1	0	4	9	0	16
4.00A.M-5.59 A.M	1	2	2	1	1	3	9	19
6.00A.M-7.59 A.M	6	7	2	6	2	9	4	36
8.00A.M-9.59 A.M	7	8	5	5	2	7	6	40
10.00A.M-11.59.M	16	6	13	8	6	17	10	76
12.00P.M-13.59 P.M	4	5	5	15	1	12	4	46
14.00P.M-15.59 P.M	10	8	4	6	4	5	9	46
16.00P.M-17.59 P.M	11	8	5	9	2	12	2	49
18.00P.M-19.59 P.M	3	2	3	3	2	2	2	17
20.00P.M-21.59 P.M	5	4	2	3	2	2	7	25
22.00P.M-23.59 P.M	4	7	2	3	1	5	1	23
Total (24 hours)	70	58	44	62	29	88	56	407

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

From the analysis of accident rate in figure 4.21, it is observed that on Dhaka-Aricha national highway during the study period maximum accidents are dominated in period 6.00 A.M to 18.00 P.M is about 71%. Generally more accidents are occurred in between time 10.00 P.M to 12.00 P.M which is about 19% of total accident occurred on this selected national highway. Considerably low accidents are observed in other periods. Especially accident frequency is very little in midnight when traffic congestion is

minimum. Accident frequency are started to increase from 6.00 AM to 12.00 P.M and then started to decreased again. The safer period in this national highway is between 18.00 P.M to 6.00 A.M. based on data analysis.

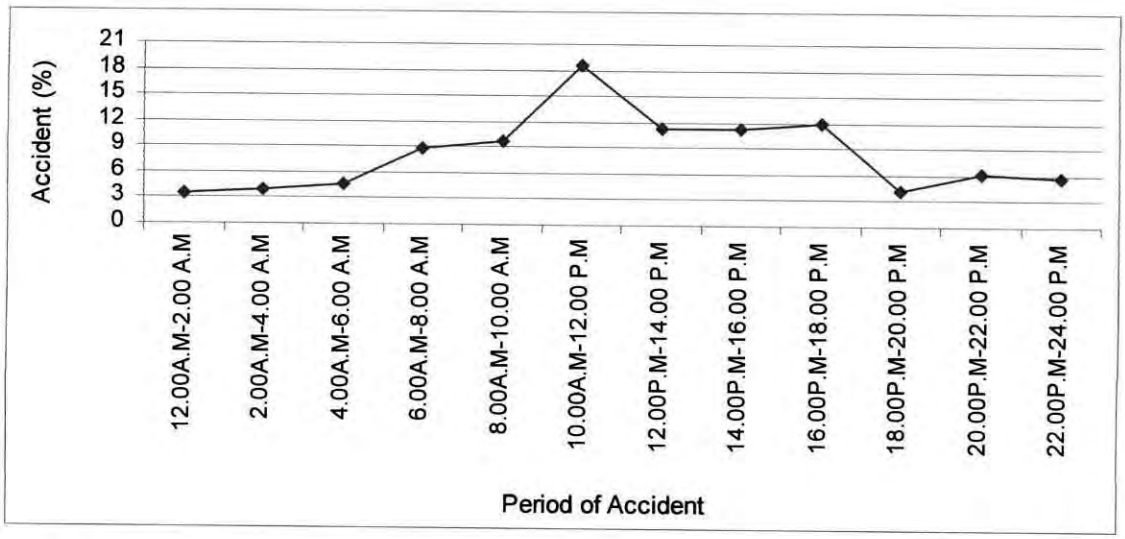


Figure 4.21: Accident frequency Hour on Dhaka-Aricha National Highway.

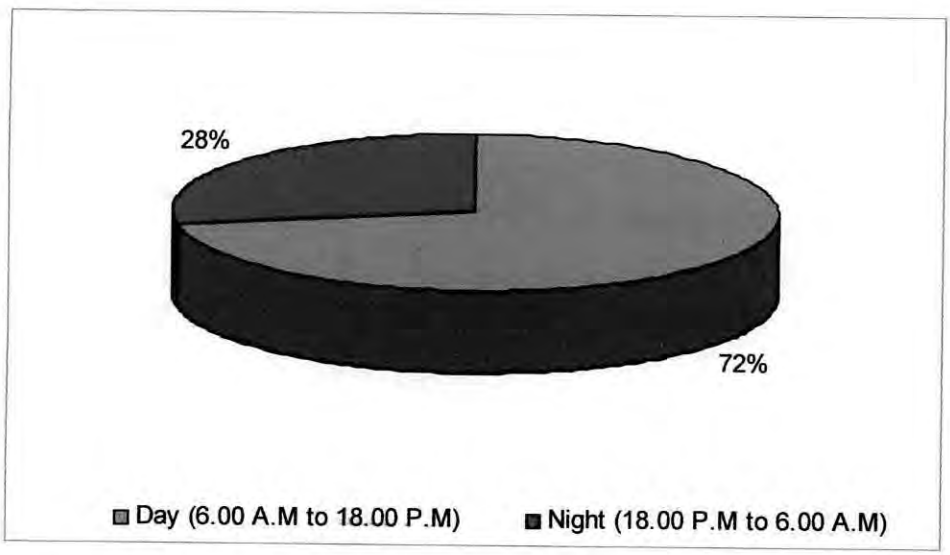


Figure 4.22: Accident over Day and Night on Dhaka-Aricha Highway

Percentage of accident analysis during day as well as night time are done separately in figure 4.22 and observed that majority number of accidents are occurred during day time over night. The last seven years study period (2000 to 2006) data analysis, it is found that on an average on Dhaka – Aricha national highway is observed around 72% of accidents are occurred by day time in comparing to night which are only 28%. The accidents frequency in day is 2.6 times more over night. From this it can be taken a result that day time journey is more risky over night on Dhaka-Aricha highway based on analysis.

Table 4.12: Accident Based on Area in Dhaka-Aricha National Highway

Year	Urban	Rural	Total
2000	16	55	71
2001	9	50	59
2002	0	44	44
2003	7	55	62
2004	2	26	28
2005	0	87	87
2006	1	55	56
Total	35	285	320

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

From the analysis of data table 4.12, it is revealed that during study period on Dhaka-Aricha national highway, most of the accidents are occurred in rural areas over urban areas. Accidents in urban areas are too small scale with respect to rural area. It is also observed that in year 2004, accident frequency in urban and rural area is comparatively low but before this year accidents frequency is considerably maximum.

More accidents are occurred after year 2005 which is almost 27% of total accidents. All accidents are occurred in rural areas during this selected year.

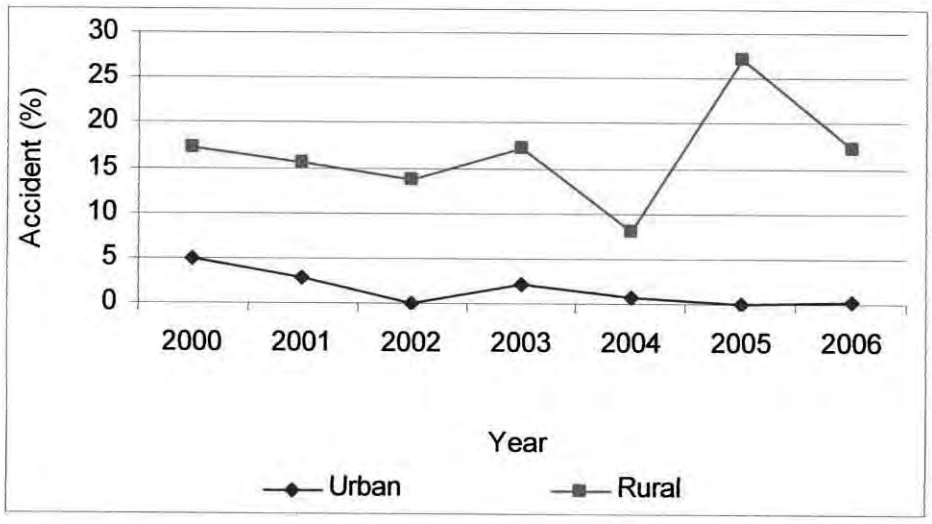


Figure 4.23: Yearly Accident Distribution Area on Dhaka-Aricha Highway

From figure 4.23, it is observed that accident frequency in rural area is always higher scale through out study period over urban area. Before year 2004, accident frequency on urban areas and rural area are considerably more. In recent year's accident frequency is a very higher scale in rural area over urban areas. Accidents frequency in rural areas is almost 8.2 times more than urban areas. Due to tendency of overtaking maneuver in rural area caused more accidents over urban area on this selected national highway.

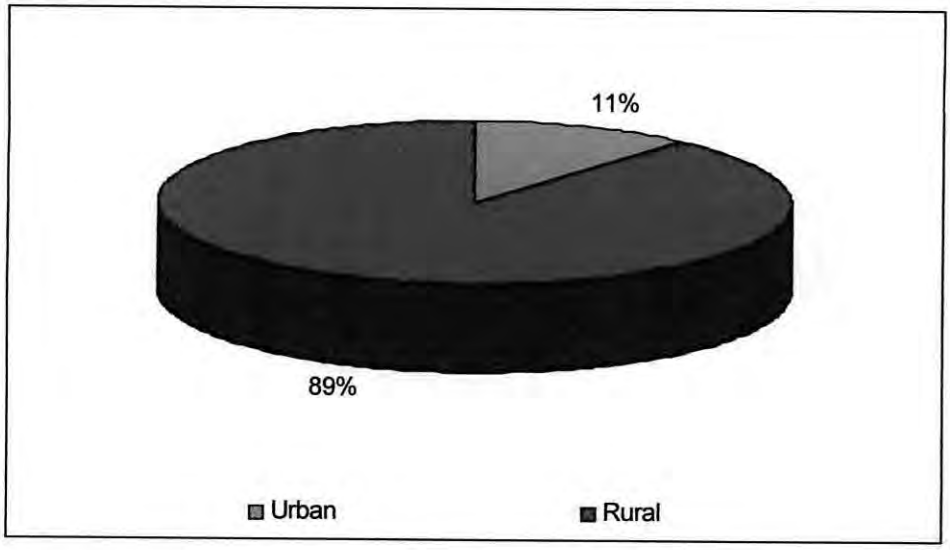


Figure 4.24: Accident Area for Dhaka-Aricha National Highway.

On this national highway after year 2004, the trend of accidents are gradually started to decrease. After year 2003, the accidents in rural areas are significantly increased. From figure 4.24, the analysis is also revealed that only around 11% accidents are occurred urban area and about 89% accidents are occurred in rural areas which are around 6.7 times more over urban area of accidents frequency on Dhaka-Aricha national highway.

4.3 Comparative Accident Analysis (N-1, N-2, N- 5)

Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways are very important highway in road transport network of Bangladesh. Accident reduction is the first aspects for this study. Comparative results of this chapter are described below among those national highways.

Maximum accidents are observed on Dhaka-Chittagong national highway based on data. Total covered study lengths of these three national highways are 257 km, 317 km and 78 km and accidents observed on Dhaka-Chittagong, Dhaka-Sylhet, and Dhaka-Aricha national highway is about 734, 486 and 410 respectively.

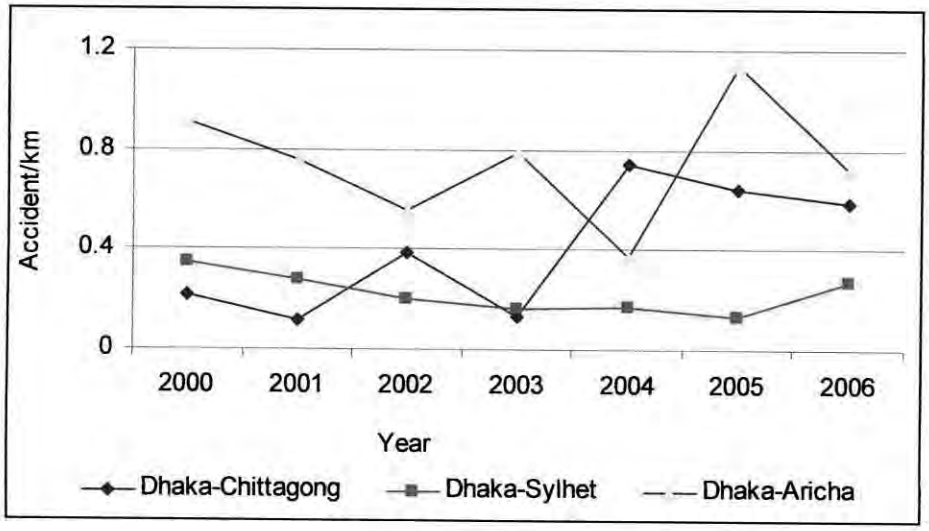


Figure 4.25: Comparison of Yearly Accident Rate.

From the analysis of figure 4.25, it is observed that the accident frequency per covered length on Dhaka-Aricha national highway is comparatively too much high over other two national highways. In year 2005, the accident frequency is too more over other study years on this highway. The figure also reveals that on Dhaka-Chittagong national highway is second one where accidents frequency per covered length is comparatively more than Dhaka-Sylhet national highway and which is greatly increased after years 2003. From figure it is also observed that though accident on Dhaka-Sylhet national highway is initially more for two years than Dhaka-Chittagong national highway but it is significantly minimum over other years. Based upon these observations it is found that Dhaka-Sylhet national highway is comparatively safer than other two national highways.

Table 4.13: Comparison of Accident Rate on Three National Highways

National Highway	Study Length (km)	Total Accident	Accident/Km
Dhaka-Chittagong	257	734	2.9
Dhaka-Sylhet	317	486	1.5
Dhaka-Aricha	78	410	5.3

From Table 4.13, it is observed that accident frequency per kilometer length is maximum 5.3 for Dhaka-Aricha national highway which is 1.8 times more than Dhaka-Chittagong national highway and 3.4 times more than Dhaka-Sylhet national highway. Dhaka-Aricha highway is the part of N-5, N-7 and N-8 as a result more vehicles have to be travelled on this national highway of South-Bengal and North-Bengal corridors. This is why, the frequent accident occurred on this highway is comparatively more.

Frequency of fatal accidents is too much high in each national highway. After fatal accidents, grievous types of accidents were similarly dominated in all three national highways. Other two types of accident have low effect in these national highways. From the analysis of accident severity rate for three national highways in figure 4.26 it is observed that fatal type accident was maximum and it was about 69% for Dhaka-Chittagong highway, 73% for Dhaka-Sylhet highway and 63% for Dhaka-Aricha highway with respects to their each total accident severity occurred. Secondly grievous types of accidents rate were occurred about 19% for Dhaka-Chittagong, 21% for Dhaka-Sylhet and

28% for Dhaka-Aricha national highway. Other accidents types have low rate accident frequency on these national highways.

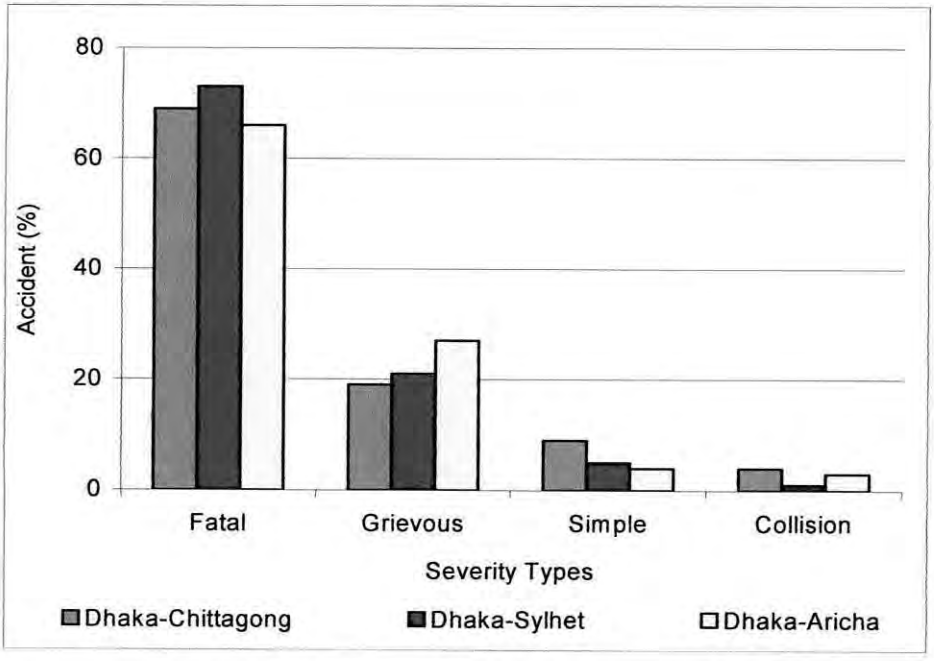


Figure 4.26: Comparative Accident Severity.

Accident fatalities are observed on Dhaka-Chittagong national highway is 1.43 times more than Dhaka-Sylhet national highway and 1.88 times more than Dhaka-Aricha national highway based on data of this study.

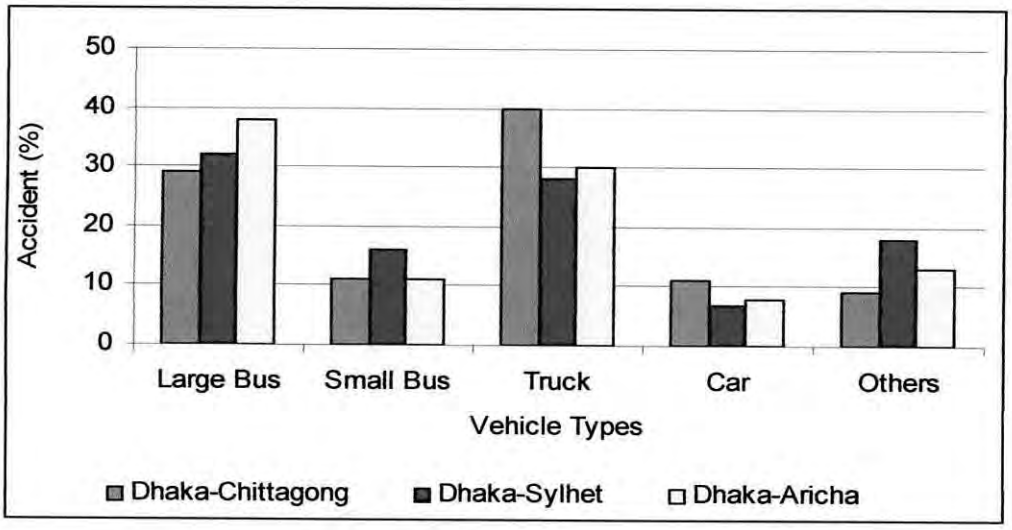


Figure 4.27: Comparative Accident Involved Vehicle Class.

From analysis of figure 4.27, it is revealed that large bus and truck is a vehicle class which are involved for maximum accidents. Total road vehicle class involved in Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway is 1013, 637 and 549. Road vehicle class involved in accident at Dhaka-Chittagong national highway is almost 1.59 times more than Dhaka-Sylhet and 1.85 times of Dhaka-Aricha national highway.

Large bus involved in accident on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways are about 29%, 32% and 39%. Similarly trucks involved in accident are about 40%, 28% and 30% to each individual accident among these national highways. Small buses also contribute more accidents which is about 11% for Dhaka-Chittagong and Dhaka Aricha national highways and 16% for Dhaka-Sylhet national highway. Other road vehicle class involvement in accidents is considerably minimum.

Moreover it is observed that the route length of Dhaka-Sylhet and Dhaka-Chittagong highways are 257 km. and 317 km respectively which is too much more with respect of Dhaka-Aricha national highway is 78 km, as a result due to more length traffic capacity is more for this reason based on data in two highways accidents contribution and vehicles involvement is more than Dhaka-Aricha national highway.

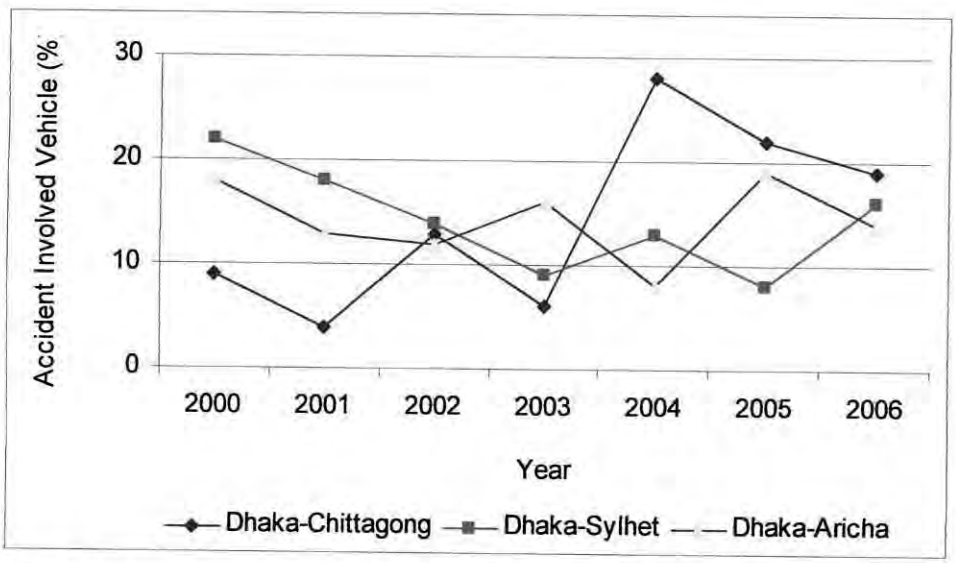


Figure 4.28: Comparative Yearly Variation of Accident Involved Vehicle Class

Figure 4.28 reveals that accident involvement vehicle on Dhaka-Chittagong national highway is comparatively low over other two national highways for first study four years and it is increased seriously after year 2003. On the other hand vehicles involvement due to accidents for other two national highways are relatively close to each other and remain nearly same through out the study period.

As Chittagong is a second large city in Bangladesh and maximum trades of the country depends upon this city. For this situation maximum vehicles as well as trucks travel more on this route. So trucks are especially responsible for more road accident trauma on Dhaka-Chittagong national highway over other two national highways.

From the analysis of accident rate distribution on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways during the study period, it is observed that maximum accidents are dominated during period 10.00A.M to 18.00 P.M. is about 23%, 27% and 30% of each national highway respectively.

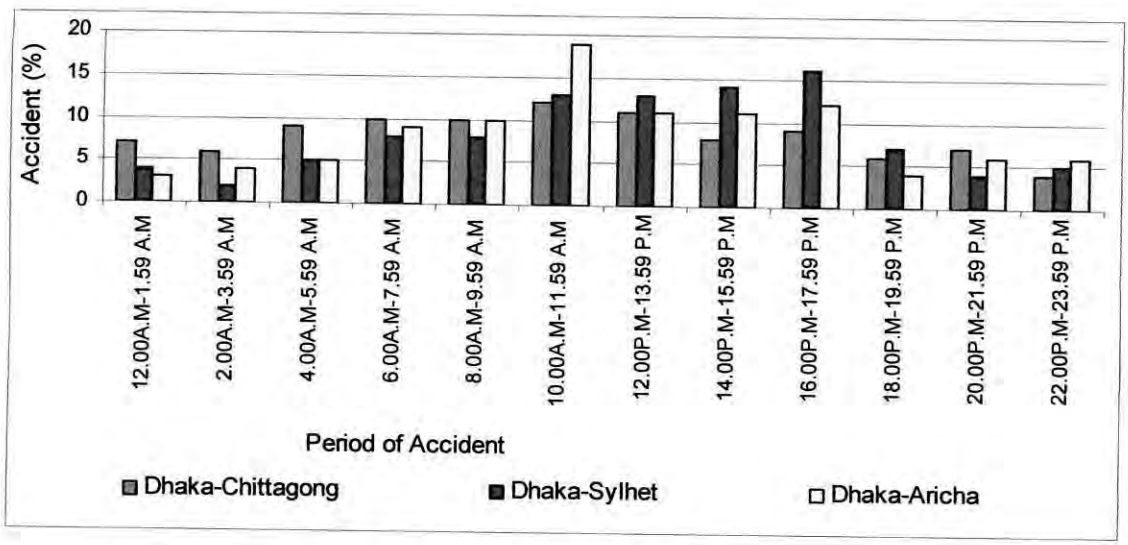


Figure 4.29: Comparative Hourly Variation of Accident.

The figure 4.29 also reveals that minimum accidents are observed on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway in each two hours variation is observe from 18.00 P.M to 6.00 A.M among three national highways during the study periods.

Maximum accidents are observed during 10.00 A.M to 18.00 P.M during study periods on three national highways. From the analysis of percentage of accident during day as well as night time, it reveals that majority of accidents were occurred during day time. The last seven years data analysis, it reveals that, on an average in Dhaka–Chittagong national highway is around 61% accidents occur at day time in comparing to just 39% at night. Similarly other two national highways such as Dhaka – Sylhet and Dhaka – Aricha, it is observed that maximum accident occurs during day time over night time and it is nearly similar around 73% at day time and 27 % at night time. From this it can be take a result that day time journey is more risky than night based on analysis data among three national highways.

Though it is found from analysis that accident rate is more in day time but one should not imply that day time driving is not for a specified length is more risky than night time. Singh (IIT, Kanpur) suggested that if one estimate accident risk per unit of per km during day as well as night time, than it will found that driving during night time is more risky than day time. Unavailability of data and time restricts this study to estimate for the probability of accident risk of an accident study of these specified three national highways.

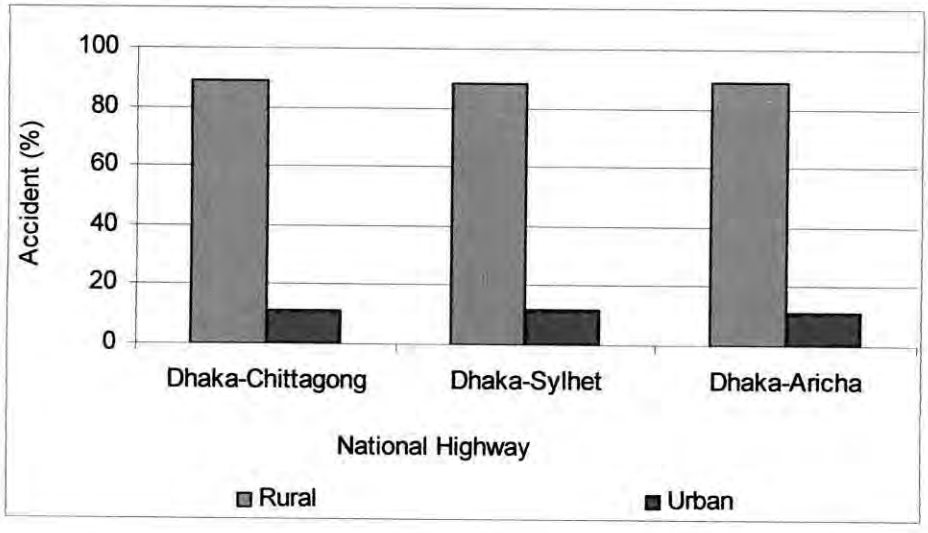


Figure 4.30: Comparative Accident Distribution Area.

It is very important to identify the area of maximum accident frequency on each national highway. From the data analysis of last seven years in figure 4.30 on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway, it is observed that maximum accidents are occurred in rural areas over urban areas. The significant reasons of more accidents on a national highway at rural area are due to excessive speed of road user class. Accidents in rural areas on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways are 89%, 88% and 91% respectively which are very higher scales over urban areas. The accidents frequency on rural area is almost eight times more than urban areas on these study national highway based on data.

After observing critically, the probable causes of accident in rural areas on any national highways are due to excessive speed of vehicle classes, drivers fell freeness to drive in rural area, not obey the traffic sign properly, due to tendency for overtaking, no other provision for slow moving vehicles etc are main contributing factors.

As the maximum accidents are occurred in rural areas in all three national highways, so extra preventive measures must be taken such as proper installation sign post, concrete post in curve, culvert, bridge portion etc must be placed or improved on these highway.

4.4 Overview

From the analysis of comparative accident characteristics, it has been found that, accident/km on Dhaka–Aricha national highway is too more than other two national highways. Fatal accidents are observed more on Dhaka-Sylhet national. Accident involved due to large bus is more on Dhaka-Aricha national highway and truck on Dhaka-Chittagong national highway. Maximum accident frequency period is 10.00 A.M to 18.00 P.M on selected three national highways. Around 88% accidents were occurred in rural areas of these three study national highways.

In the next chapter a comparative study on ADT with accident on these three selected national highways are done which are main factors of accident, are precisely described.

CHAPTER-5

COMPARATIVE ADT AND ACCIDENT STUDY

5.1 Introduction

Traffic flow varies over time. Traffic flow in a particular road may vary over hours, days, months, year etc. In Transportation Engineering, the study of vehicular flow characteristics carries great importance because the same imply useful information for developing highways, transportation planning, performing economic analysis, performance evaluation of transport facility, establishment of geometric criteria etc. Accident analysis confirms that the higher the impact speed, the greater the likelihood of serious and fatal injury. These studies prove useful in correlating accident with average daily traffic among three selected national highways for safe and effective traffic movement. Depending on the specific information required the following studies carried out.

- Average Daily Traffic Study on Dhaka-Sylhet national highway
- Observed Vehicle Speed Studies on Dhaka-Sylhet national highway
- Comparative ADT and Accident study on three selected highways.

5.2 Data Collection

Design considerations and performance evaluation of highway is not possible using either incorrect or assumed traffic data. This may the road networks to be inadequately facilitated or over designed. But so far collected and preserved traffic flow data on Bangladesh-UK Friendship Bridge by toll operators is providing a good opportunity for the transportation planners to effectively utilize these data for traffic flow analysis. Therefore, this study avails fair amount of quality traffic data for traffic flow characteristics analyses and observed vehicle speed data on Dhaka-Sylhet corridor in Bangladesh.

5.3 Description of Study ADT Area on Dhaka-Sylhet Highway

The study area of average daily traffic is a bridge site in where all traffic was counted automatically according to their class. This bridge is located on Dhaka – Sylhet National Highway on river the Meghna which was connected Bhairab bazaar and Ashuganj. This bridge is situated 110m apart from Rail Bridge.

Photograph 5.1: Bangladesh-UK Friendship Bridge from Ashuganj End.

This bridge was constructed by Roads and Highways Department under Ministry of Communication. The construction company of this bridge was Admand Natal Ltd., UK and Consultant Company was Halco Group, UK, Bangladesh Consultant Ltd. and Engineering Science Lt. Total money spend for this project was around 681 corer taka. Length of main bridge is 929m, approach viaduct at Bhairab end is 141m and approach viaduct of Ashuganj end is 123m. Approach road of Bhairab end is 839m and Ashuganj end is 586 m. The width of main bridge is 19m (2x1.5n + 16m) with four lanes. In foundation of the bridge, 2m dia and 70m length cast in situ pile had been used. The bridge has ten number of Pier with nine Span. In present, SIGMA (Malaysia) – RCL (Bangladesh) Joint Venture operates the bridge.

Photograph 5.2: Bhairab End Toll Plaza at Bangladesh–UK Friendship Bridge.

Photograph 5.3: Bridge Sight View from Bhairab End.

In Bhairab – Ashuganj Toll Plaza all average daily traffic is counted with in three shift in a day. 1st shift is started from 6.00 A.M to 14.00 P.M, 2nd shift is started from 14.00 P.M to 22.00 P.M and last 3rd shift is started from 22.00 P.M to 6.00 A.M. The seven days ADT data in three shifts has been collected for this study from 01-12-2007 to 07-12-2007 from the toll plaza of project area.

5.4 Average Daily Traffic Study on Dhaka-Sylhet Highway

The major objectives of this study are to analysis traffic flow data on the selected North-East corridor Dhaka - Sylhet national highway. Primarily the flow patterns have been developed to see the nature of traffic flow fluctuation and then various flow characteristics have been established. Using the summarized database of traffic flow on Bangladesh-UK Friendship Bridge, a range of analysis on traffic flow has been rendered during this study. The variation of traffic flow is very important aspects of flow characteristics which are very useful to know the effect on accident frequency on this national highway.

Table 5.1: Vehicle Classifications and Toll Rate

Vehicle Class	Vehicle Name	Toll Rate (T.K.)
Class 1	Motor Cycle/Baby Taxi/Mishuk	10
Class 2	Maxi/Pick-Up Van/Pick-Up/Tempo	30
Class 3	Car/Jeep/Station Wagon/Micro	100
Class 4	Coaster/Tracter/Tracter With Trailer	125
Class 5	Mini Bus/ Mini Truck	150
Class 6	Small Bus/Small Truck/Covered Truck 2 Axle	200
Class 7	Large Bus/Large Truck/Covered Truck 3 Axle	300
Class 8	Trailer Truck/ Construction Equipment	400

Source: SIGMA-RCL JV, Bhairab-Ashuganj toll plaza, January 2008.

Table 5.2: Symbol Used for Vehicle Types

Vehicle Name	Symbol Used
Motor Cycle/Baby Taxi/Mishuk	MC
Maxi/Pick-Up Van/Pick-Up/Tempo	Maxi
Car/Jeep/Station Wagon/Micro	Car
Coaster/Tracter/Tracter With Trailer	Tracter
Mini Bus/ Mini Truck	MB/MT
Small Bus/Small Truck/Covered Truck 2 Axle	SB/ST
Large Bus/Large Truck/Covered Truck 3 Axle	LB/LT
Trailer Truck/ Construction Equipment	TT

5.4.1 Variability in Traffic Stream

It is an obvious statement that traffic flow varies over time. These variations are observed over a number of time scales such as –time of day, day of week, season of the year. Traffic also varies from place to place, facility to facility depending on numerous parameters viz. economic, agricultural cycles, culture, religious, recreational activities, function of facility, surroundings locality, purpose of trip and many other factors (Hamid, 2006).

5.4.2. Daily Traffic Fluctuation on Dhaka-Sylhet National Highway

Table 5.3: Combined Three Shifts Traffic Flow from Dhaka to Sylhet

Vehicle Type	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
MC	297	336	358	173	332	373	407
Maxi	136	161	219	92	138	152	176
Car	273	420	458	357	498	524	715
Tractor	9	5	13	6	10	13	10
MB/MT	56	74	95	89	90	86	87
SB/ST	873	1152	1089	1137	1142	1179	1172
LB/LT	15	29	28	23	17	17	30
TT	2	1	5	3	8	1	5

Source: SIGMA-RCL JV, Bhairab-Ashuganj toll plaza, January 2008.

Daily traffic variation pattern has been developed after the data collection from Bhairab-Ashuganj toll plaza. Average daily traffic based on seven days continuous flow on this highway from Dhaka to Sylhet was obtained 2166 veh/day. From figure 5.1, it reveals that vehicle class six such as small bus, small truck, covered truck 2 axle are travel on this national highway is too much higher quantity over other vehicle class. After analysis of seven days traffic data it reveals that around 51% vehicle class six of total vehicles travel on this national highway from Dhaka to Sylhet direction. Car, jeep, station wagon, micro

bus etc has another significant effect on this national highway is about 21% of total daily traffic which also travel from Dhaka towards Sylhet. Motor cycle, baby taxi, mishuk are about 15% of total traffic move daily from Dhaka to Sylhet. Other vehicle class type has comparatively less quantity on this national highway. Maximum traffic flow is observed on Friday.

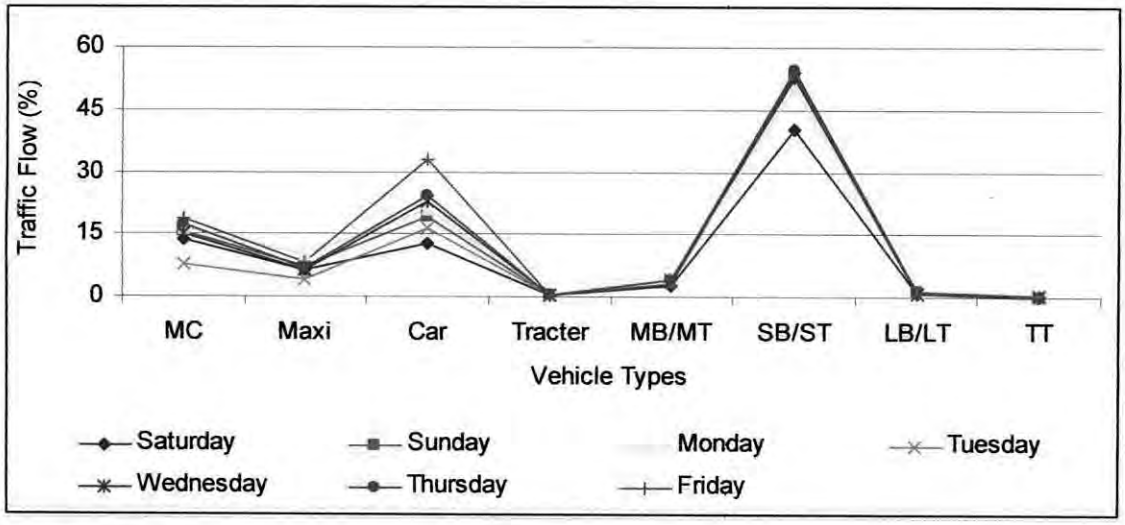


Figure 5.1: Variation of Traffic Flow Based on Day from Dhaka to Sylhet.

Table 5.4: Combined Three Shifts Traffic Flow from Sylhet to Dhaka

Vehicle Type	Saturday	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
MC	384	335	352	340	329	371	419
Maxi	186	173	219	150	137	146	177
Car	581	422	432	117	482	468	706
Tractor	9	5	13	8	7	29	14
MB/MT	54	65	86	85	74	80	92
SB/ST	1084	995	994	974	966	1028	1087
LB/LT	23	25	17	14	22	11	12
TT	2	2	5	1	0	4	4

Source: SIGMA-RCL JV, Bhairab-Ashuganj toll plaza, January 2008

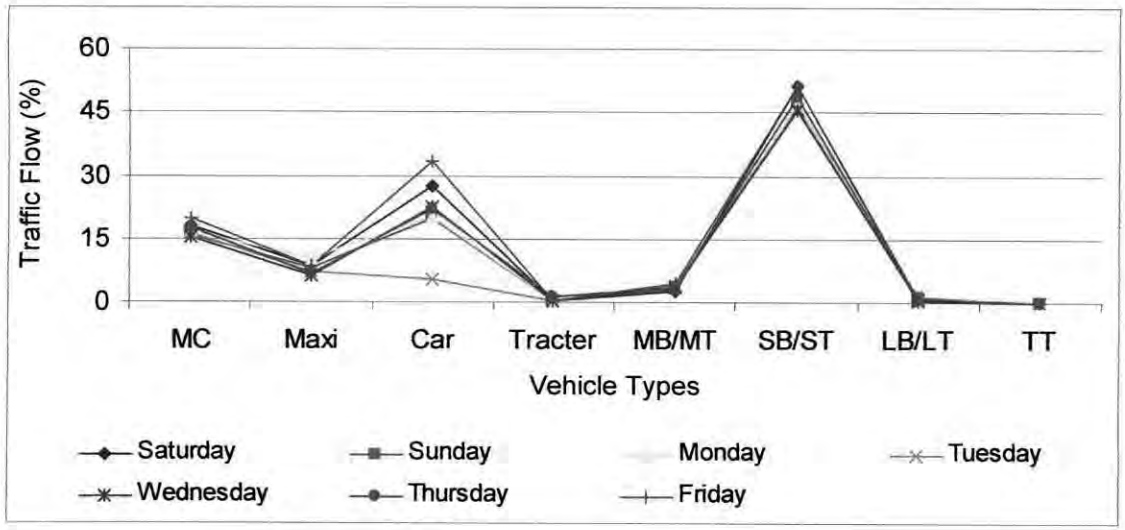


Figure 5.2: Variation of Traffic Flow Based on Day from Sylhet to Dhaka.

From figure 5.2, after analysis of seven days traffic flow data it reveals that around 48% vehicle class six of total vehicles travel on this national highway from Sylhet to Dhaka direction. Car, jeep, station wagon, micro bus etc has another significant effect on this national highway is about 22% of total daily traffic which also travel from Sylhet towards Dhaka. Motor cycle, baby taxi, mishuk are about 17% of total traffic move daily from Sylhet to Dhaka. Other vehicle class type has comparatively less quantity on this national highway.

5.4.3 Traffic Flow Based for Shift on Dhaka Sylhet Highway

Table 5.5: Average Traffic Flow for First Shift

Vehicle Type	MC	Maxi	Car	Tractor	MB/MT	SB/ST	LB/LT	TT	Total
Traffic Flow	258	122	348	11	50	700	16	2	1505

Source: Bhairab – Ashuganj Toll Plaza, SIGMA – RCL JV, January, 2008

From table 5.5 and figure 5.5 it reveals that vehicle class six; small bus and small truck are observed more than other vehicle class. The analysis of average traffic flow data it is

observed that during period 6.00 A.M to 14.00 P.M this vehicle class is about 47 % of total vehicles in this shift. Car, jeep, micro has another significant effect on travel is about 23% and motor cycle, baby taxis and mishuk have also considerable travel effect during this shift and it is about 17% of total quantity of vehicle.

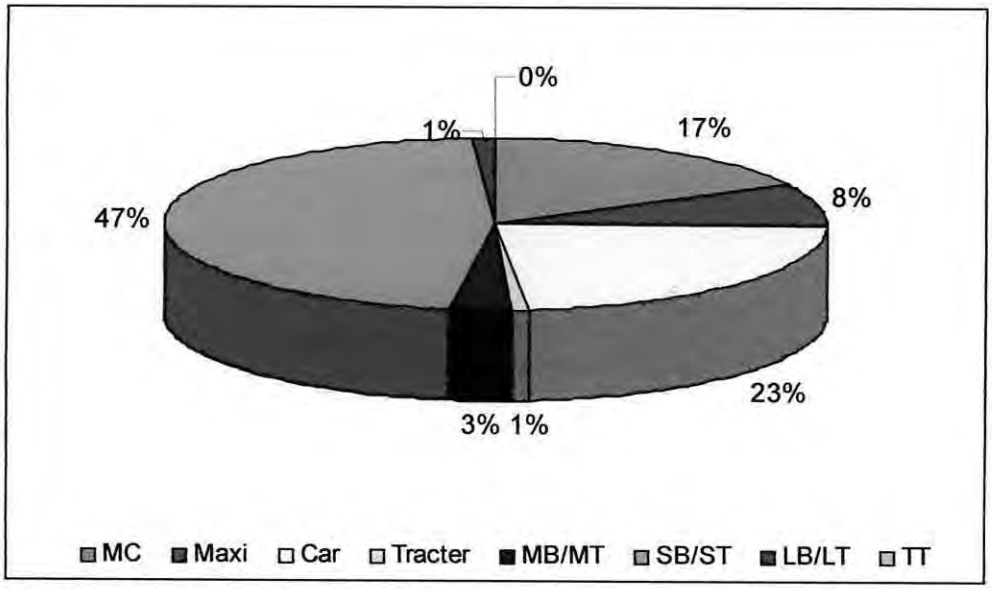


Figure 5.3: Traffic Flow for First Shift on Dhaka-Sylhet Highway

Table 5.6: Average Traffic Flow for Second Shift.

Vehicle Type	MC	Maxi	Car	Tractor	MB/MT	SB/ST	LB/LT	TT	Total
Traffic Flow	381	170	434	8	57	686	13	2	1749

Source: Bhairab – Ashuganj Toll Plaza, SIGMA – RCL JV, January, 2008

From the analysis of data table 5.6 and figure 5.4 it is observed that period 14.00 P.M to 22.00 P.M vehicle class six such as small bus and small truck are traveled in large scale are around 39% of total observed vehicle in second shift. After this quantity than flowed by vehicle class three such as car, jeep, micro which is about 25% and vehicle class one such as motorcycle, baby taxi and mishuk are about 22% of total observed vehicles in this shift on this national highway. Maxi, pick-up, tempo are also travel significantly on this highway during the second shift of traffic flow.

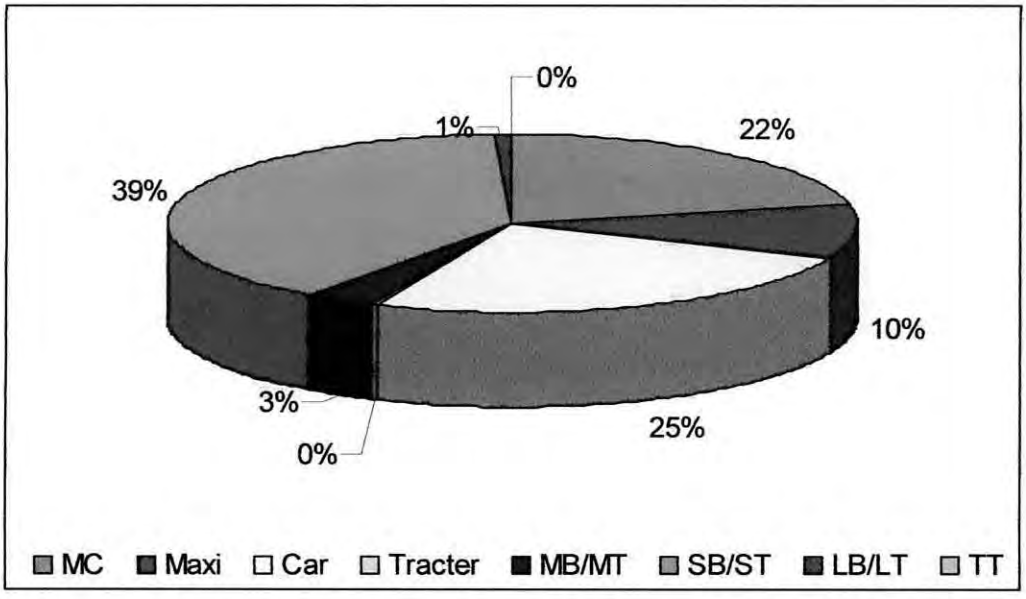


Figure 5.4: Traffic Flow for Second Shift on Dhaka-Sylhet Highway

Table 5.7: Average Traffic Flow for Third Shift.

Vehicle Type	MC	Maxi	Car	Tractor	MB/MT	SB/ST	LB/LT	TT	Total
Traffic Flow	47	31	182	2	52	737	12	2	1063

Source: Bhairab – Ashuganj Toll Plaza, SIGMA – RCL JV, January, 2008

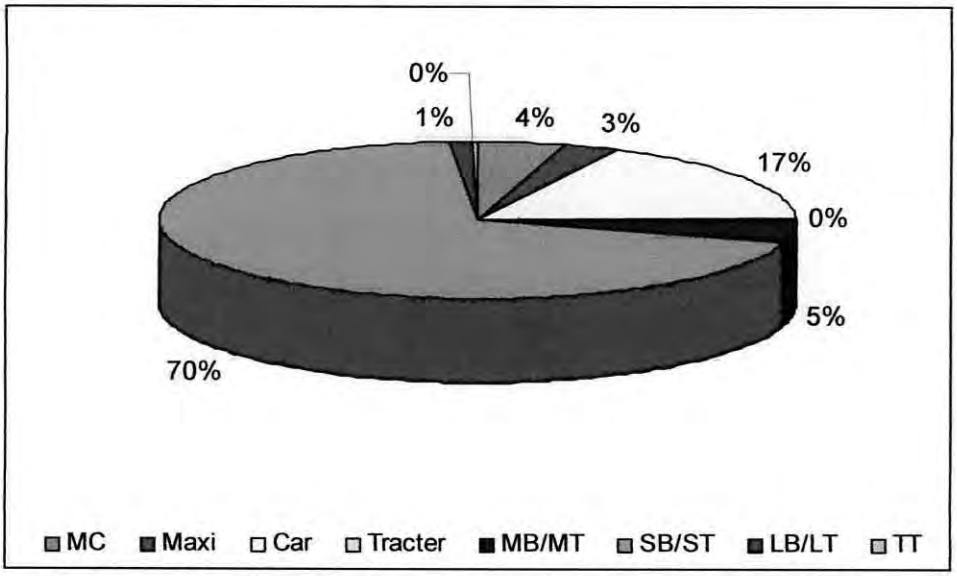


Figure 5.5: Traffic Flow for Third Shift on Dhaka-Sylhet Highway

From the analysis of data table 5.7 and figure 5.5 it is also revealed that during period 22.00 P.M to 6.00 A.M vehicle class six such as small bus and small truck are traveled in very large scale are around 70% of total observed vehicle in third shift on a day. After this quantity than flowed by vehicle class three such as car, jeep, micro which is about 17% of total observed vehicle during this shift. And other vehicle classes have very less effect on travel during this last shift.

Table 5.8: Average Traffic flow from Dhaka to Sylhet Direction

Vehicle Type	MC	Maxi	Car	Tractor	MB/MT	SB/ST	LB/LT	TT	Total
Traffic Flow	325	153	464	9	82	1106	23	4	2163

Source: Bhairab – Ashuganj Toll Plaza, SIGMA – RCL JV, January, 2008

From the analysis of data table 5.8 and figure 5.6 it is revealed that the average traffic flow from Dhaka to Sylhet direction is about 2163. Out of which vehicle class six such as small bus and small truck are traveled in large scale are around 52% of total observed vehicle in this direction. After this quantity than flowed by vehicle class three such as car, jeep, micro which is about 21% and than followed by vehicle class one such as motorcycle, baby taxi, mishuk and this is about 15% of total vehicle observed in this direction. Other vehicle classes have comparatively less effect on travel this direction.

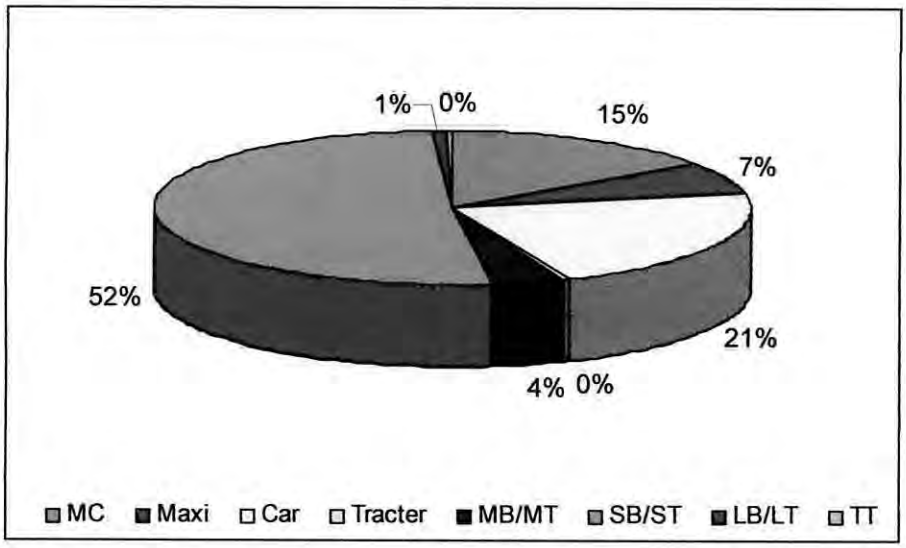


Figure 5.6: Traffic Flow from Dhaka to Sylhet Direction.

Table 5.9: Average Traffic Flow from Sylhet to Dhaka Direction

Vehicle Type	MC	Maxi	Car	Tractor	MB/MT	SB/ST	LB/LT	TT	Total
Traffic Flow	361	170	501	12	77	1018	15	3	2154

Source: Bhairab – Ashuganj Toll Plaza, SIGMA – RCL JV, January, 2008

From the analysis of data table 5.9 and figure 5.7 it is revealed that the average traffic flow from Sylhet to Dhaka direction is about 2154 which is nearly same of vehicle coming from opposite direction. Out of this total vehicle class six such as small bus and small truck are traveled is also a large scale are around 46% of total observed vehicle in this direction. After this quantity than flowed by vehicle class three such as car, jeep, micro which is about 23% and than followed by vehicle class one such as motorcycle, baby taxi, mishuk and this is about 17% of total vehicle observed in this direction. Other vehicle classes have comparatively slight effect on travel this direction.

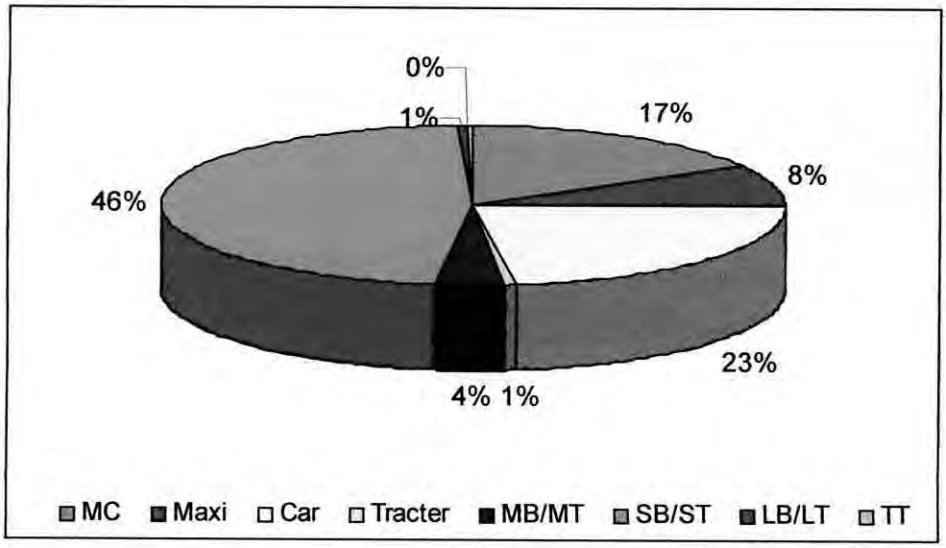


Figure 5.7: Daily Traffic Flow from Sylhet to Dhaka Direction.

.Table 5.10: Average Daily Traffic (ADT) on Dhaka-Sylhet National Highway

Vehicle Type	MC	Maxi	Car	Tractor	MB/MT	SB/ST	LB/LT	TT	Total
Average Daily Traffic	686	323	964	21	159	2123	41	6	4317

Source: Bhairab – Ashuganj Toll Plaza, SIGMA – RCL JV, January, 2008

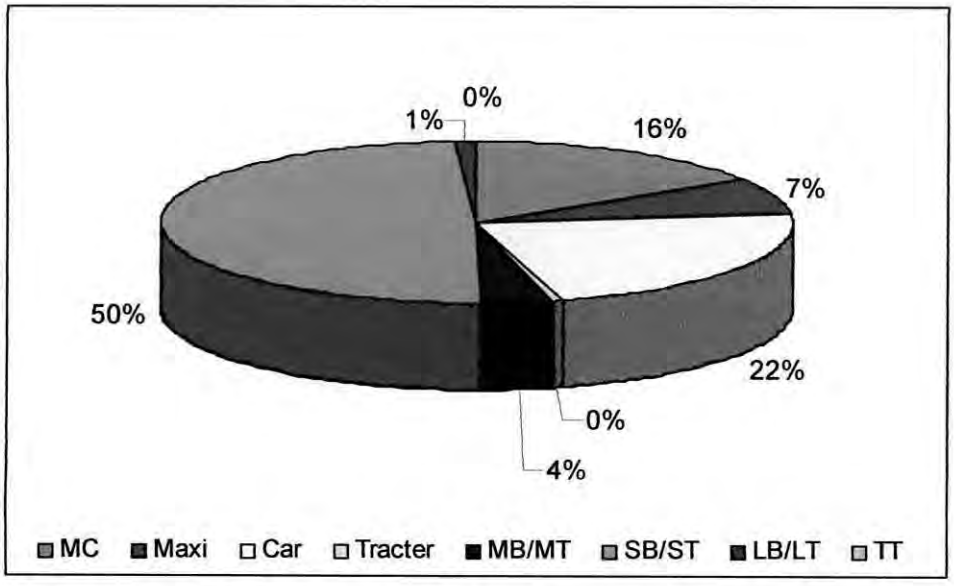


Figure 5.8: Traffic Flow from Dhaka-Sylhet National Highway.

From the analysis of data table 5.10 and figure 5.8 it is revealed that the average daily traffic on Dhaka-Sylhet national highway is about 4317. Out of this total vehicle, vehicle class six such as small bus and small truck are traveled in exactly one half of total observed vehicle on this national highway. After this quantity than flowed by vehicle class three such as car, jeep, micro which is about 22% and than followed by vehicle class one such as motorcycle, baby taxi, mishuk and this is about 16% of total vehicle observed on this national highway. Vehicle class two such as maxi, pick-up, and tempo has also mentionable effect 7% on this national highway. Other vehicle classes have comparatively less effect on travel on this national highway.

5.5 Speed Study on Dhaka-Sylhet National Highway

Speeding, defined as driving at a speed unsafe for conditions or exceeding the posted speed limit, is cited as one of the most prevalent factors that contribute to crashes. In 1994, speeding was cited as a contributing factor in 12 percent of all police-reported accidents in the United States. Speeding was also listed as a factor in 31 percent of all fatal crashes. The economic cost to society of speed-related crashes is currently estimated to be $24

billion annually (Janet et al, 1995). As Dhaka-Sylhet national highway plays a vital role in interregional road transport on Bangladesh, so speed management is the first aspects for accident reduction on this national highway.

For study of average vehicle class speed the selected section is straight but a sharp horizontal curve is situated about 350m ahead. For this, it is noted that the actual road user class speed is affected for a horizontal curve and observed vehicle speed is less than actual speed of vehicle on this study national highway. All the road user class speed was measured in loaded condition. Due to the limited time and manpower for this study, around two hours thirty minutes observation was done during evening period on selected 188'-0" length section on Hajibagh area and average time was than counted during observation for different user class to calculate average vehicle speed on Dhaka-Sylhet national highway. In this study observations are done on 55 numbers of vehicles out of which large bus is 7 nos, large truck is 2 nos, small bus is 9 nos, small truck is 5, minibus is 3 nos, mini truck is 1 nos, private car is 7 nos, micro is 4 nos, tempo 8 nos, tractor is 1 nos, motorcycle is 4 nos, pick up is 4 nos.

Table 5.11: Average Observed Vehicle Speed on Dhaka-Sylhet Highway.

Vehicle Name	Average Speed (km/h)
Large Bus	77
Large Truck	40
Small Bus	55
Small Truck	43
Minibus	47
Mini Truck	35
Private car	68
Micro	67
Tempo	25
Tractor	18
Motor Cycle	46
Pick up	38

Source: Survey Data on Hajibagh Station, Dhaka-Sylhet Highway, 6th January, 2008.

From the analysis of vehicle speed from data table 5.11, it is observed that average speed of vehicle in this highway is not excessive. Maximum speed of vehicle observed in this highway at this section for large bus is about 77 km/hour. Private car and Micro bus have also more speed and which is about 68 km/hour. The speed of other types of vehicle is in reasonable speed value. The small bus and small truck have an average vehicle speed is 55 km/hour and 43 km/hour. These two types of vehicles travel more in this highway. The percentage of these two types of vehicle is about 50% of total ADT on this highway. So from this study a conclusion may be taken that this highway is a safer highway with respect to the average running speed of vehicle.

5.6 Comparative Accident, ADT and Speed Study on Dhaka-Sylhet Highway

Continuous traffic flow data on Bangladesh-UK Friendship Bridge, accident data from Accident Research Institute (ARI), BUET and field observed vehicle speed data on Dhaka-Sylhet national highway are used. Primarily the accident data and average daily traffic data have been developed to see the nature and fluctuation of these parameters on this national highway.

Table 5.12: Average Daily Traffic Rate on Dhaka-Sylhet National Highway

Vehicle Class	Average Daily Traffic
Motor Cycle, Baby Taxi, Mishuk	15.8%
Maxi, Pick-up Van, Pick-up, Tempo	7.4%
Car, Jeep, Station Wagon, Micro	22.3%
Coaster, Tractor, Tractor with Trailer	0.49%
Minibus, Mini truck	3.7%
Small bus, Small truck, Covered truck 2-axle	49.2%
Large bus, Large truck, Covered truck 3-axle	0.95%
Trailer Truck, Construction Equipment	0.16%
Total	100%

From data table 5.12 it is observed that on Dhaka-Sylhet national highway small bus, small truck and covered truck 2-axle plays a very significance roll on transport. Almost 50% vehicles are these types of vehicle class which transport passengers, freights etc. More than one fourth vehicles are car, jeep, station wagon, micro etc. on this national highway. Local transport such as motorcycle, baby taxi, Mishuk etc have also a significant effect is about 16% of total vehicles on this national highway.

Table 5.13: Accident Involved Vehicle on Dhaka-Sylhet National Highway

Vehicle Type	Involved in Accident (%)	Average Speed (km/h)	Average Daily Traffic (%)
Large Bus	31.6	77	0.95
Small Bus	16.3	55	49.2
Truck	27.8	43	
Car	6.6	68	26
Motor Cycle, Push Cart, Tempo, Artic, Oil Truck, Tractor	17.7	46	24

From the analysis of the data table 5.13 it is revealed that large bus makes a significant part in accident over other types of vehicles on Dhaka-Sylhet national highway. The accident involvement rate for large bus is about 32% which is very large scale because only 1% of total vehicles are large bus plays on this highway. The average speed is observed for these large buses are about 77 km/h. One the other hand small bus and trucks involved on accidents are about 44% of total accident. On this national highway the affect of this types of vehicles are about 50% of total average daily traffic which is significantly maximum both in accidents and daily traffic movement.

Involvement of accident due to car is about 7% which is also comparatively high as it has also a significant quantity for transport is about 22% of total observed vehicles on this national highway. The average daily traffic rate of motor cycle, baby taxi, Mishuk is about 16% where as accidents involvements due to these types of vehicles are about 18% which is objectionable rate for this national highway.

Table 5.14: Relationship between Accident and ADT

Period	% of Average Daily Traffic	Accident (%)
6.00 A.M to 14.00 P.M	35	43
14.00 P.M to 22.00 P.M	41	41
22.00 P.M to 6.00 A.M	25	16

From analysis of the data table 5.14, it reveals that maximum accidents are occurred in first shift during 6.00 A.M to 14.00 P.M is about 43% of total accident in where the average daily traffic on this highway during this period is 35% of total traffic which is comparatively more over other periods. Small bus and small trucks are traveled during this period is about 47% of total vehicular flow which are responsible for maximum accident on this national highway.

During second shift in period 14.00 P.M to 22.00 P.M, the accident frequency is also significantly more as maximum vehicle classes is about 41% of ADT are traveled in this period. The accidents involved in this period are about 41% of total accidents. Small buses and small trucks are observed in this period is about 39% of total traffic flow during this shift on Dhaka-Sylhet national highway.

The last third shift is safer period as accident frequency as well as average daily traffic rate is comparatively minimum on Dhaka-Sylhet national highway. During period 22.00 P.M to 6.00 A.M, average daily traffic is observed around 25% and accident frequency is about 16% which is considerably minimum over other periods. In this last shift small bus and small trucks are traveled in a large scale over other vehicle which is about 69% of total observed traffic flow in this shift. The reason for minimum frequency of accident in this shift is, due low traffic congestion and minimum public participation

5.7 Comparative Average Daily Traffic and Accident Study

In this study, average daily traffic data for Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway is collected and presented in the table 5.15 for make a comparison.

Table 5.15: Average Daily Traffic of Three National Highways

Average Daily Traffic									
Vehicle Type	MC	Maxi	Car	Tractor	MB/MT	SB/ST	LB/LT	TT	Total
Dhaka-Sylhet	686 (15.9%)	323 (7.5%)	964 (22.3%)	21 (0.49%)	159 (3.7%)	2123 (49.2%)	41 (0.95%)	6 (0.14%)	4317 (100%)
Dhaka-Chittagong*	1771 (18.2%)	851 (8.7%)	1864 (19.2%)	0 (0%)	1047 (10.8%)	3459 (35.5%)	743 (7.6%)	0 (0%)	9735 (100%)
Dhaka-Aricha*	651 (11.6%)	181 (3.2%)	756 (13.4%)	0 (0%)	579 (10.3%)	2134 (38%)	1322 (23.5%)	0 (0%)	5623 (100%)

Source: Roads and Highways Department, 2008

*Note: *ADT of 2002 on Dhaka-Chittagong and Dhaka-Aricha Highway.*

From the above table, it is observed that average daily traffic of Dhaka-Chittagong national highway is comparatively more than other two national highways. As average daily traffic data for Dhaka-Sylhet national highway is collected from toll plaza and large portion of bus and truck on this highway is counted as vehicle class six, so quantity of large bus and large truck on this highway is found too less particularly on Dhaka-Sylhet national highway.

Average daily traffic of Dhaka-Chittagong national highway is around 2.3 times more than Dhaka-Sylhet and 1.7 times more than Dhaka-Aricha national highway based on study data.

From figure 5.9, it is clearly revealed that small bus and small tracks are contributed more on these three national highways. Bus and trucks are observed 43.2%, 50.1% and 61.5%

of average daily traffic on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway respectively.

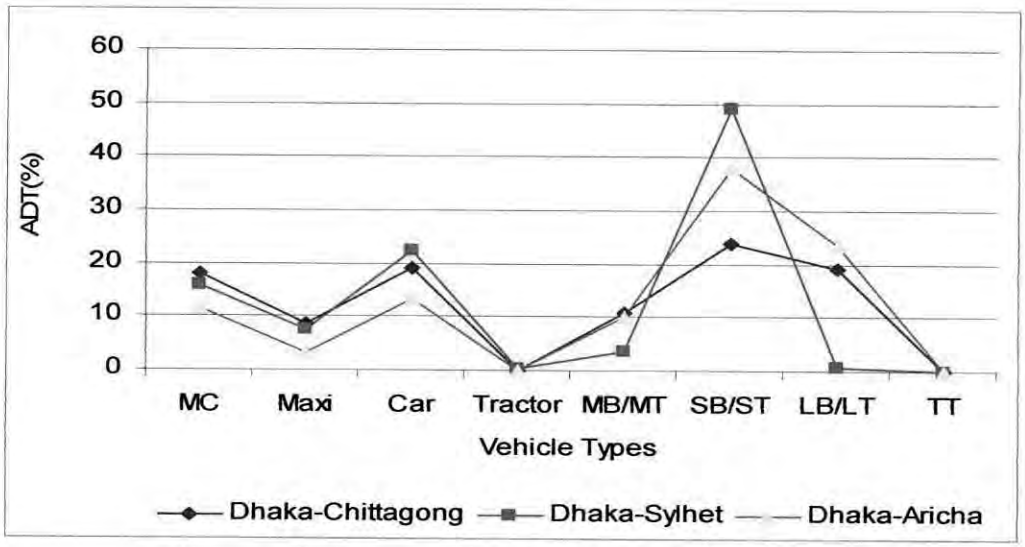


Figure 5.9: Comparative of Average Daily Traffic.

Table 5.16: Comparative ADT and Accident on Three National Highways

Vehicle Types	Dhaka-Chittagong		Dhaka-Sylhet		Dhaka-Aricha	
	ADT (%)	Accident (%)	ADT (%)	Accident (%)	ADT (%)	Accident (%)
Large Bus	7.5	29.3	0.95	31.6	23.5	38.4
Small Bus	38	11	49.2	16.3	38	10.9
Truck		29.5		27.8		29.5
Car	29.9	11.1	26	6.6	23.7	7.7
Motor Cycle, Push Cart, Tempo, Artic, Oil Truck, Tractor	26.9	9.1	24	17.7	14.8	13.5

From the analysis of table 5.16, it is observed clearly the comparative relationship among vehicle types, average daily traffic and accident involvement frequency on three national highways. Due to difference of vehicle types classification system among RHD and Bhairab-Ashuganj toll plaza, maximum buses and trucks on Dhaka-Sylhet national

highway is counted with small bus and small truck. For limitation of vehicle classification system, large bus is observed less quantity on Dhaka-Sylhet national highway. On the other hand small buses and trucks travel on these three national highways is a very large number over other types of vehicles and it considerably more on Dhaka-Sylhet national highway which is about 50% of total observed vehicles. Accident contributions by these vehicles are observed 41%, 44.1% and 40% on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway and clearly it is shown more on Dhaka-Sylhet national highway. From table it is also observed that though Motor Cycle, Push Cart, Tempo, Artic, Oil Truck, Tractor etc is comparatively more on Dhaka-Chittagong national highway but accident involvement is significantly less than other two national highways.

5.7 Overview

Average daily traffic on Dhaka-Chittagong national highway is 9735 which is around 2.3 times more than Dhaka-Sylhet and 1.7 times more than Dhaka-Aricha national highway. Maximum observed vehicles are small bus and small trucks which are significantly more on Dhaka-Chittagong national highway. Small bus and trucks are about 38%, 49.2% and 38% of average daily traffic and accident involvement are about 40.5%, 44.1% and 40.4% on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway. Maximum speed is observed for large buses are about 77 km/h on Dhaka-Sylhet national highway.

The next chapter six discussed about accident black spot on Dhaka-Sylhet national highway and accident comparison among two nodes and two junctions on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway.

CHAPTER – 6

COMPARATIVE ACCIDENT BLACK SPOT STUDY

6.1 Introduction

The study area envisaged a total length of 317 km along on Dhaka-Sylhet national highway which is started from km. post 13, is a reference point at Katchpur Bridge and ends at km. post 330 is a reference point at Tetli bus stand. It is a very important segment of national highway network in Bangladesh. This highway links the capital city of Bangladesh with Sylhet division. This national highway serves as a main highway which connects north-east part of Bangladesh with Dhaka. The Dhaka-Sylhet national highway plays a vital role in interregional road and transport in Bangladesh. As this national highway is very important highway in Bangladesh, so accident reduction as one of the chief objectives including safety improvements for different black-spots area. Comparative black spot study among Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway is principal aspect in this chapter.

This chapter contains the identification of accident black spots, diagnosis of collected data, available geographical, geometrical information's, probable causes of accident with remedial improvements, detail analysis of average daily traffic and observed vehicle speed of this important national highway. Finally, recommendations are made based on the findings of the study which may help to implement safety improvement measures for other highways more effectively in the future.

For analysis of accident black spots on Dhaka-Sylhet national highway (N-2) three years data such as year 2001 to 2003 for past Dhaka-Sylhet highway and year 2004 to 2006 for new Dhaka-Sylhet national highway are collected from Accident Research Institute (ARI), BUET, Dhaka-1000.

6.2. Definition of Accident Black Spots

In Bangladesh, RHD define a spot as accident black spot identification if in a spot at least 12 accidents including 3 fatalities occur during the study period of three years (RHD Report, 1999). As it is found that Dhaka-Sylhet highway is safer road based on data analysis and no spot is observed which can fulfill the criteria of this RHD accident black spot definition, so a black spot on Dhaka-Sylhet national highway is identified by using the part of RHD definition which is minimum three fatal accidents occurred with in consecutive three full calendar years. Moreover in this analysis, every selected black spot on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways fully satisfied the criteria of priority value fifteen, definition in Belgium, Denmark and Australia and other separate specific definitions of black spot in Norway and Newzeland.

The identification of specific highway spots with high accidents frequency rate are the first step of any black spot management programme. Apart from the accident analysis, black spot management requires to conduct a detailed site inspection taking into account the following elements:

1. The spots and its traffic features
2. The highway spots environment
3. The vehicles as well as the road users' situation.

After the identification and diagnosis of black spots, a selection of treatments is made resulting in recommendations for the improve measures.

6.3 Black Spot Data Collection

The Accident Research Institute (ARI) is an authority who has developed a computer program for rural investigations which lists the accidents on each highway by road section and intersection, defined as a kilometer distance from a control point. For this reason, all accident data is collected based on kilometer post on three selected national highways.

Accident severity, Casualty of accident, Period based accident and Environmental factor based accident data for Dhaka-Sylhet highway in Km. Post used in this study which is collected from secondary data source, Accident Research Institute (ARI), BUET. This secondary data for each black spot locations which included all necessary information's for initial identification of each black spot. The accident data information is collected for the three years period which is from year 2001 to 2003 for past highway route and year 2004 to 2006 for new highway route which is tabulated in this study for easy reference. For this study preliminary ten spots are selected and data was than collected first and after this five spots are identified of further detail investigation for this study on Dhaka-Sylhet national highway. For comparative black spot study, accident severity and casualty data with collision types are also collected for selected site and node on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway.

6.4 Analysis of Accident Black Spot on Dhaka-Sylhet Highway

In this study all available accidents related data of black spot was tabulated, analyzed and discussed. Out of these ten black spots five black spots were selected for detail analysis and investigation with probable causes and make suggestions for reduction of accidents.

6.4.1 Study on Shaheprotab Black Spot

This selected black spot is located at Km. Post 50 from Dhaka end on Dhaka-Sylhet National Highway. At Shaheprotab black spot, total five accidents are occurred during year 2001 to 2003 where all accidents are fatal type. As this spot satisfies partly the criteria of RHD black spot definition and fully satisfies the priority value fifteen with other available black spot definitions applied for other countries, so this spot is identified as an accident black spot on Dhaka-Sylhet national highway.

Table 6.1: Accident and Casualties on Shaheprotab.

Time	Total Accidents	Vehicles involved	Casualties			
			Fatal	Grievous	Simple	Total
12.00 A.M-1.59 A.M	0	0	0	0	0	0
2.00 A.M-3.59 A.M	0	0	0	0	0	0
4.00 A.M-5.59 A.M	0	0	0	0	0	0
6.00 A.M-7.59 A.M	0	0	0	0	0	0
8.00 A.M-9.59 A.M	0	0	0	0	0	0
10.00 A.M-11.59 A.M	2	2	2	0	0	2
12.00 P.M-13.59 P.M	0	0	0	0	0	0
14.00 P.M-15.59 P.M	0	0	0	0	0	0
16.00 P.M-17.59 P.M	1	1	1	0	0	1
18.00 P.M-19.59 P.M	0	0	0	0	0	0
20.00 P.M-21.59 P.M	1	2	1	1	0	2
22.00 P.M-23.59 P.M	1	1	1	0	0	1
Total	5	6	5	1	0	6

Source: Accident Research Institute (ARI), BUET, 2007, Dhaka-1000

From the analysis of accident distribution bar diagram 6.1, at Shaheprotab round about it is observed clearly that total five accidents are occurred where six vehicles are involved during the study period 2001 to 2003. Total casualty is observed six. It is also found that maximum two accidents occurred where two persons are died between 10.00A.M to 12.00 P.M. Except this mentioned time, between 20.00 P.M to 22.00 P.M another accident is also occurred where one person is died and one other person is seriously injured. Out of these mentioned periods no accidents are observed in this black spot during this study period.

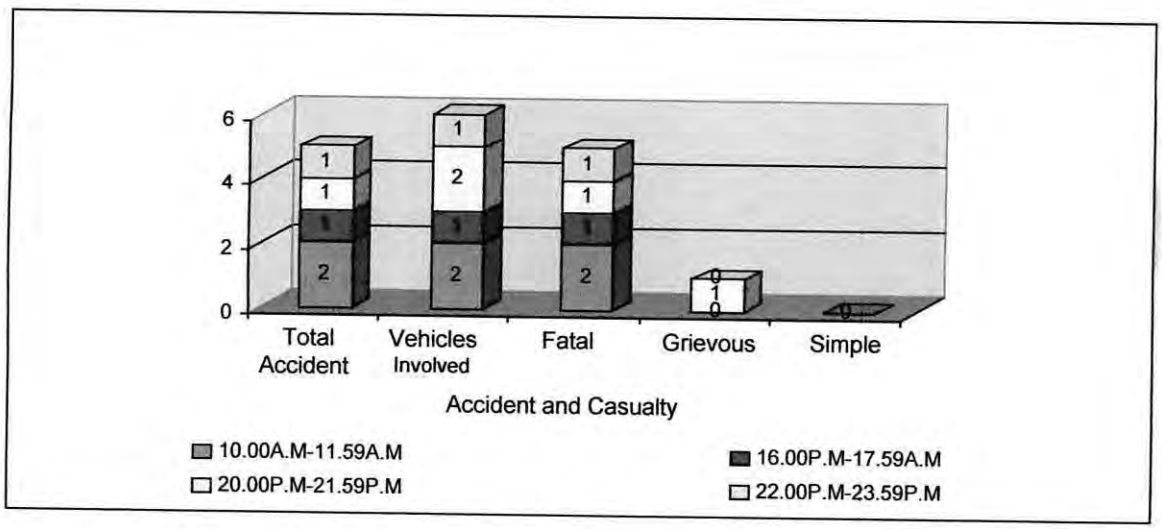


Figure 6.1: Bar Diagram of Accident Distribution at Shaheprotab Black Spot.

Table 6.2: Accident Severity Based on Weather at Shaheprotab.

Weather	Severity				
	Fatal	Grievous.	Simple	Collision	Total
Fair	5	0	0	0	5
Rain	0	0	0	0	0
Wind	0	0	0	0	0
Fog	0	0	0	0	0
Total	5	0	0	0	5

Source: Accident Research Institute (ARI), BUE), 2007, Dhaka-1000

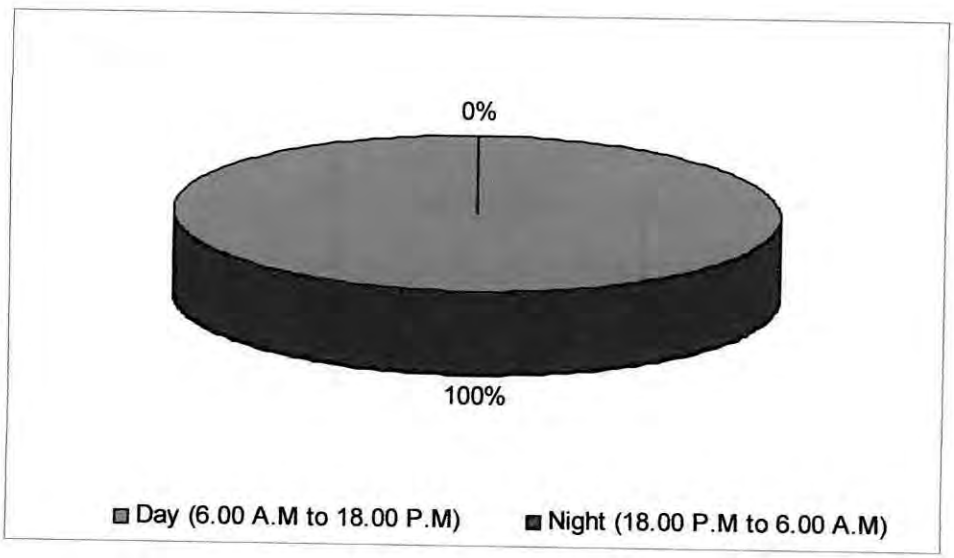


Figure 6.2: Accident Frequency Day and Night at Shaheprotab.

From the analysis of accident table 6.2, it is observed that during study period of three years at selected Shaheprotab station on Dhaka-Sylhet national highway, all accidents are occurred at a normal weather condition. In the study three years 2001 to 2003, no accident is observed in adverse rain, wind or foggy climate. From data it is also revealed that all accidents are fatal type on this selected black spot.

From another analysis based on day and night in figure 6.2, it is also observed that all five fatal accidents are occurred at day time at this black spot during the study period. It may be traffic congestion is too more at day over night around the round about which are very important contributory factors for an accident.

Description of Shaheprotab Black Spot

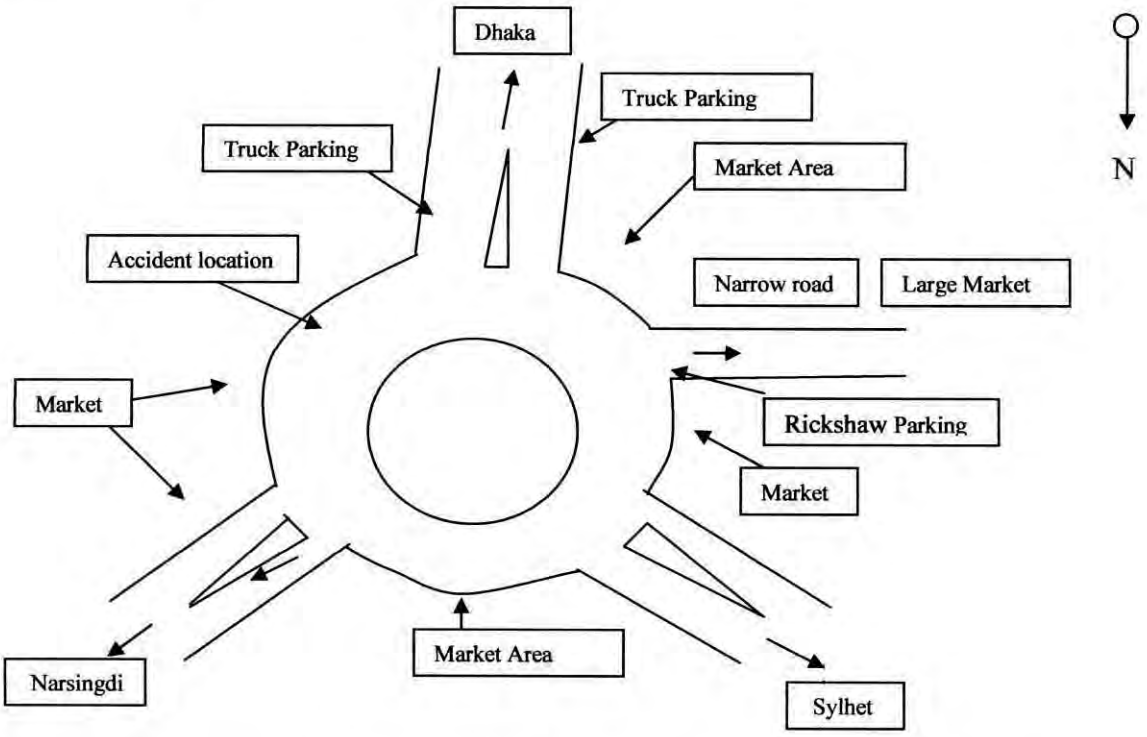
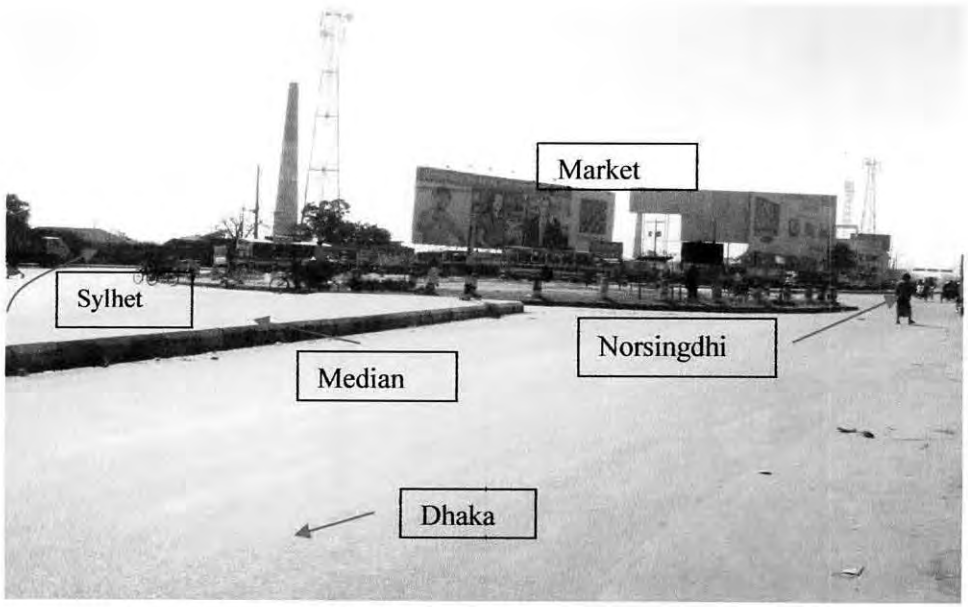
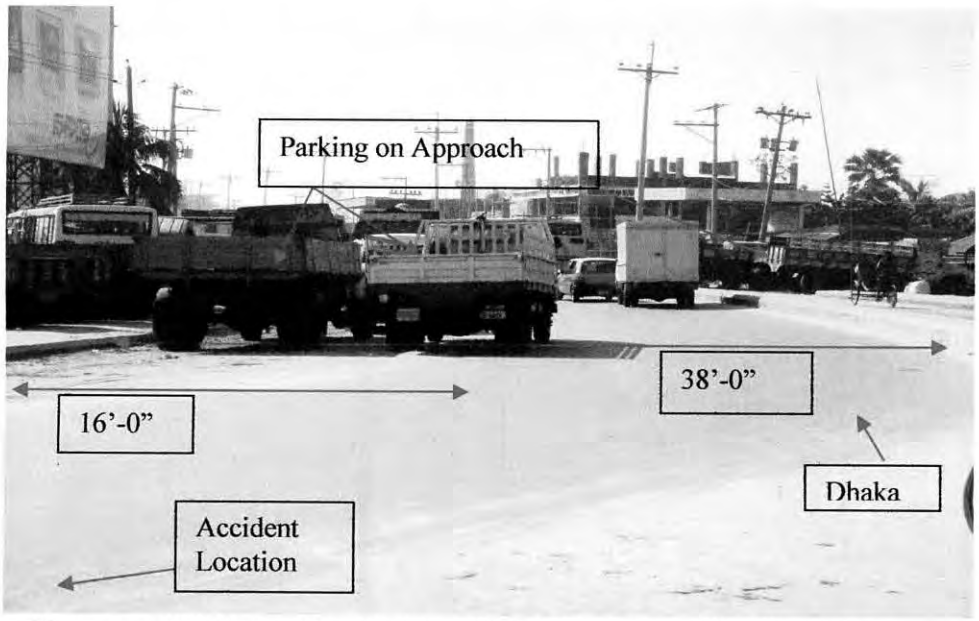


Figure 6.3: Layout for Shaheprotab Black Spot. (Not in scale)

From figure 6.3 it is observed a round about in the intersection of three highways. Three roads coincide in this spot from Dhaka, Norsingdhi and Sylhet. This spot is a very busy business area. All kinds of vehicles such as bus, truck, tempo, baby, rickshaw, van etc were traveled through this spot. Moreover rickshaw, bus, truck parking is also around the round about. Too many shopping malls are surrounded at this location. This roundabout is canalized. Concrete posts are present around the roundabout and Dhaka-Norsingdhi curve portion. This spot is too much busy and dangerous because of fast and slow moving vehicles are always negotiating with each other here. The truck parking is found a common figure on main approach road in a segregate condition. Footpath is also present on Dhaka-Sylhet and Dhaka-Norsingdhi curve portion on this round about but peoples are unwilling to use those. The highway in this spot is in four lanes towards Dhaka.



Photograph 6.1: Black Spot at Shaheprotab Roundabout.



Photograph 6.2: Accident behind Truck Parking at Shaheprotab

Probable Causes of Accidents at Shaheprotab Roundabout

Mixed traffic makes this spot too much dangerous. Rickshaw and truck parking on the main approach around the roundabout here and there is a common scenario. No sign post about the round about before entrance vehicle coming from Dhaka. Large business areas with different shops are present around the roundabout, so public participation in this spot is too much high. No service road for slow moving local vehicles. No access control system in this spot. No systematic way of road crossing. Local bus, tempo stands around the round about for passengers and it makes disturb and obstacle for drivers of fast moving vehicles and causes a great possibility often for rear end collision. Though highway is four lanes but due to parking of other vehicles the effective width come too much narrow.

Probable Remedial Improvements at Shaheprotab Roundabout

Installation of proper warning post before entering this black spot in all three directions of main approach roads mentioning a round about especially coming vehicle from Dhaka which negotiate at a curve portion. Provide separate crossing system of pedestrians for prevent segregate road crossing. Control slow moving non motorized vehicle to enter this spot. Improving footpath and forced people to use it. Proper and quick install of breaking concrete post around the round about. Provide access control in this spot. Truck parking should be taken away another place instead of main approach. Speed breaker or speed restriction sign post should install quickly before entrance in this black spot. Slow moving vehicle should not allow to entire or parking on the main highway around the round about especially for rickshaw. Local bus and tempo stand should be taken away another location and keep free for first moving vehicle around the round about.

6.4.2 Study on Baraitala, Kararchar Black Spot

This black spot is located at km. post 57 on Dhaka – Sylhet national highway. In this black spot total five accidents are occurred during the year from 2004 to 2006 and all accidents were fatal type. In RHD definition of black spot, it is said that if total twelve accidents are occurred in a spot where three accidents are fatal types than it is defined as accident black spot. In Belgium, Denmark, Australia, the definition of black spot is, if the priority value is equal to fifteen of a spot than it is called black spot. Though this spot satisfies partly the criteria of RHD black spot definition and fully satisfies the priority value fifteen, so this spot is identified as an accident black spot.

Table 6.3: Accident and Casualties on Baraitala Black Spot.

Time	Total Accidents	Vehicles involved	Casualties			
			Fatal	Grievous	Simple	Total
12.00 A.M-1.59 A.M	0	0	0	0	0	0
2.00 A.M-3.59 A.M	0	0	0	0	0	0
4.00 A.M-5.59 A.M	1	1	1	0	0	1
6.00 A.M-7.59 A.M	0	0	0	0	0	0
8.00 A.M-9.59 A.M	1	1	1	0	0	1
10.00 A.M-11.59 A.M	0	0	0	0	0	0
12.00 P.M-13.59 P.M	0	0	0	0	0	0
14.00 P.M-15.59 P.M	2	3	2	6	0	8
16.00 P.M-17.59 P.M	1	1	1	0	0	1
18.00 P.M-19.59 P.M	0	0	0	0	0	0
20.00 P.M-21.59 P.M	0	0	0	0	0	0
22.00 P.M-23.59 P.M	0	0	0	0	0	0
Total	5	6	5	6	0	11

Source: Accident Research Institute (ARI), BUET, 2007, Dhaka-1000

From the analysis of data table 6.3 and accident distribution in bar diagram at figure 5.7, it is observed total five accidents are occurred where six vehicles are involved during the study period 2004 to 2006. Total casualty of this spot is eleven. Maximum two accidents are occurred between 14.00 P.M to 16.00 P.M in which total two persons are died and six persons are seriously injured. On the other mentioned period significantly low accidents are occurred during study year. Out of these periods no accident is observed in this black spot during the study period.

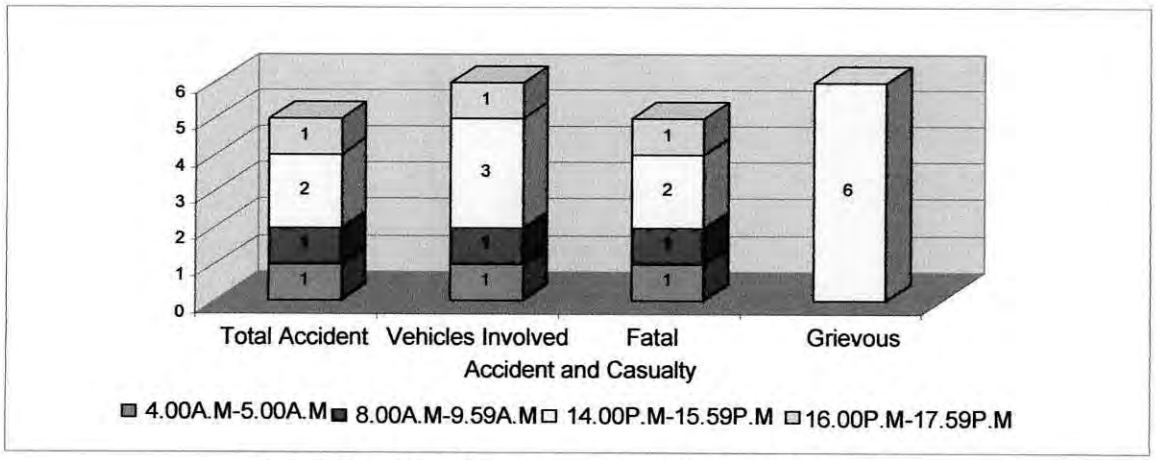


Figure 6.4: Bar Diagram of Accident at Baraitala.

Table 6.4: Accident Severity Based on Weather at Baraitala.

Weather	Accident Severity			
	Fatal	Simple	Collision	Total
Fair	5	0	0	5
Rain	0	0	0	0
Wind	0	0	0	0
Fog	0	0	0	0
Total	5	0	0	5

Source: Accident Research Institute (ARI), BUET, 2007, Dhaka-1000

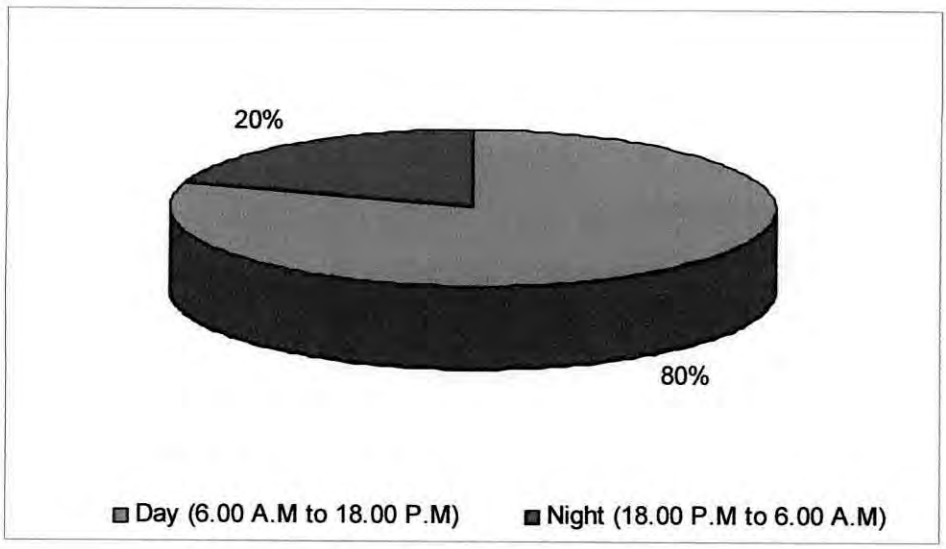


Figure 6.5: Accident for Day and Night at Baraitala

From the analysis of data table 6.4, it is observed that during study period of three years in Baraitala, Kararchar station, all accidents are occurred at a normal weather condition. In the study of three years 2004 to 2006, no accident is observed in adverse rain, wind or foggy climate and it is also revealed that all accidents are fatal types.

From another analysis based on day and night in figure 6.5, it is also observed that four fatal accidents are occurred during sunlight and another fatal accident is occurred at night time at this black spot during the study period. It may be tendency of local traffic in crossing the main highway is more at day time over night. Another subsequent reason of day time as well as night time accident in this spot is, it my fail to understand of sudden presence intersection when drivers are negotiating curve path at day and night.

Description at Baraitala Black Spot

This black spot is located on Dhaka-Sylhet national highway after Shaheprotab round about at Baraitala village, Kararchar union and Shippur Thana. Two village roads connect with the main national highway, out of which one road connects the Gojaria bazaar, Polash Thana and another road connects Putia bazaar, Shippur Thana. The position of two connecting road make this spot as an intersection. Levels of these two roads are very low with a gentle slope. This location is a small village market area. Several shops are present at the side of these two side roads. One large factory is situated at very adjacent side of main approach highway. After around 80m apart towards Sylhet from this intersection 1st culvert and 2^{nd} culvert are found. Another narrow side road towards Bhuiabari connects with this highway. A large brick field is present at the side of this spot. After 100m of 2^{nd} culvert a sharp horizontal curve is found in this black spot.

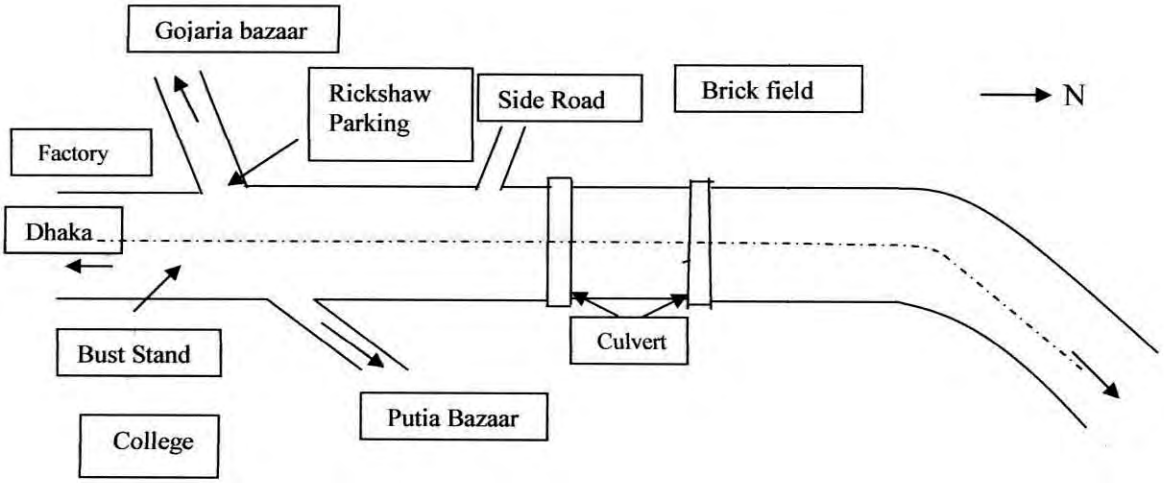
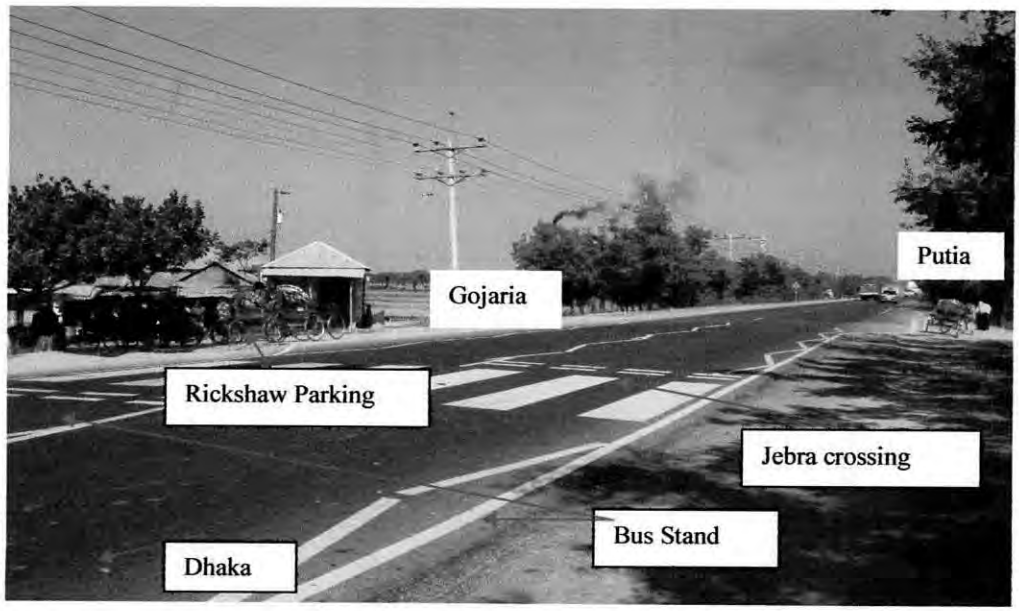


Figure 6.6: Black Spot at Baraitala on Dhaka-Sylhet Highway (not in scale).

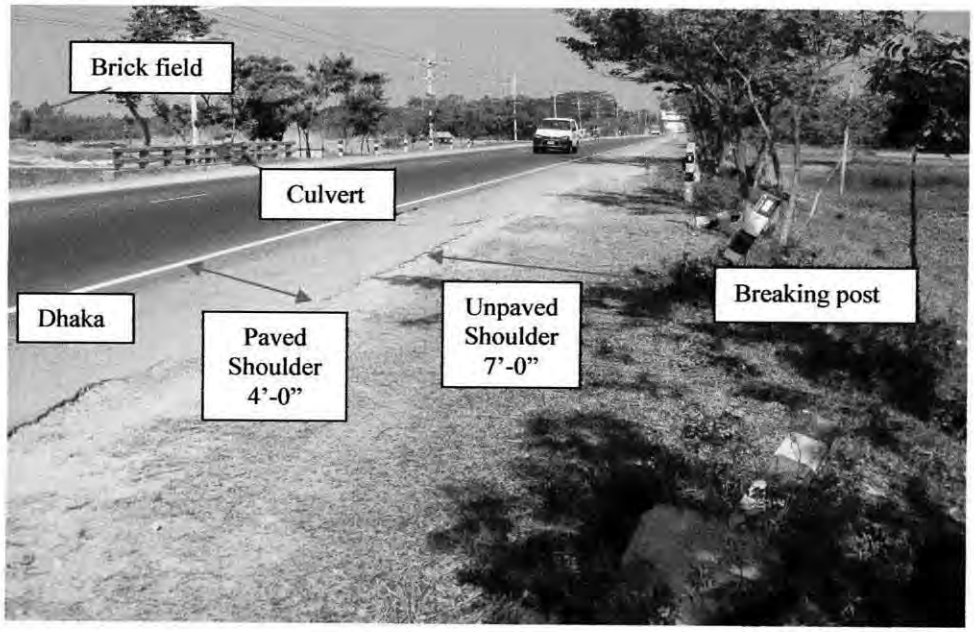


Photograph 6.3: Baraitala Bazaar Bus Stand on Dhaka-Sylhet Highway.

Probable Causes of Accidents at Baraitala, Kararchar Black Spot

Fast moving vehicles coming towards this spot from Dhaka with a very high speed and suddenly negotiate this intersection without any prior information. Slow moving non motorized vehicles crossing this inter section independently which makes a surprise to the driver of other vehicles. Local motorized traffic stands in this spot for passengers in both

sides which make a possibility for rear end collision. Tendency of overtaking in this spot which is because drivers are fail to understand the actual traffic condition at this spot. No presence of speed breaker or speed limit restriction sign at this location. Deep holes were found on the soft shoulders for different locations. Paved shoulders are also damaged for several locations at this spot. No warning sign for 1st culvert and side road for brick field. There are also found no warning sign for 2nd culvert and sharp curve.



Photograph 6.4: Culvert and Brick field at Baraitala Black Spot.

Probable Remedial Improvements at Baraitala Black Spot

Restrict or safety provision for slow moving vehicle to cross the highway from one side to another side at this site. Installation of proper speed limit sign should be done at this spot from two ends. Fill or improvements of the soft shoulders should be done quickly. Proper warning sign must install at this location mentioning market area, site road, brick field etc. Some concrete post beside the culvert which are broken down should be removed and install as urgent basis. Rickshaw parking should take away to another place instead of main highway. On curve concrete post should be install with chevron.

6.4.3 Study on Itakhola Black Spot

This Black Spot is located at Km. Post 59 on Dhaka-Sylhet national highway. At this selected black spot total five accidents are occurred during the year from 2004 to 2006 where four accidents are fatal type and another accident is grievous type. As this selected spot satisfies partly the criteria of RHD black spot definition and fully satisfies the priority value fifteen with other available black spot definitions applied for other countries, so this spot is identified as an accident black spot on Dhaka-Sylhet national highway.

Table 6.5: Accident and Casualty at Itakhola Black Spot

Time	Total Accidents	Vehicles involved	Casualties			
			Fatal	Grievous	Simple	Total
12.00 A.M-1.59 A.M	0	0	0	0	0	0
2.00 A.M-3.59 A.M	0	0	0	0	0	0
4.00 A.M-5.59 A.M	1	1	1	0	0	1
6.00 A.M-7.59 A.M	2	2	2	0	0	2
8.00 A.M-9.59 A.M	1	1	0	1	0	1
10.00 A.M-11.59 A.M	0	0	0	0	0	0
12.00 P.M-13.59 P.M	0	0	0	0	0	0
14.00 P.M-15.59 P.M	0	0	0	0	0	0
16.00 P.M-17.59 P.M	1	1	1	0	0	1
18.00 P.M-19.59 P.M	0	0	0	0	0	0
20.00 P.M-21.59 P.M	0	0	0	0	0	0
22.00 P.M-23.59 P.M	0	0	0	0	0	0
Total	5	5	4	1	0	5

Source: Accident Research Institute (ARI), BUET, 2007, Dhaka-1000

From the analysis of accident and casualty table 6.5 and accident distribution bar diagram in figure 6.7, it is observed that maximum accidents are occurred between 6.00 A.M to 8.00 A.M during 2004 to 2006. Maximum vehicles are also involved due to accident during this period on this selected black spot. Fatal accidents are also involved more during this period. Similarly grievous accidents are occurred in the mentioned period. Other mentioned period, significantly minimum accidents are occurred at this selected black spot. Out of these mentioned periods no accident are observed during this study year at this selected Itakhola black spot.

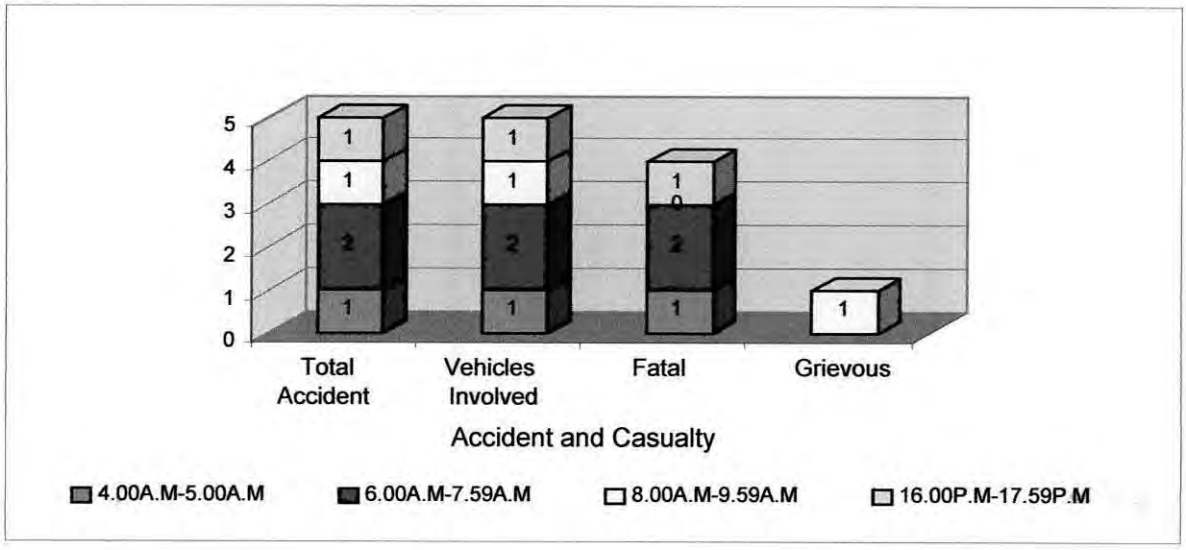


Figure 6.7: Bar Diagram of Accident Distribution at Itakhola.

Table 6.6: Accident Severity Based on Weather at Itakhola.

Weather	Fatal	Grievous.	Simple.	Total
Fair	4	1	0	5
Rain	0	0	0	0
Wind	0	0	0	0
Fog	0	0	0	0
Total	4	0	0	5

Source: Accident Research Institute (ARI), BUET, 2007, Dhaka-1000

From the analysis of data table 6.6, during the study period in 2004 to 2006, it is observed that at this black spot all accidents are occurred in normal weather condition. Four accidents are fatal types and another accident is grievous type. During last three years no accident is occurred in the adverse rain, wind, foggy climate.

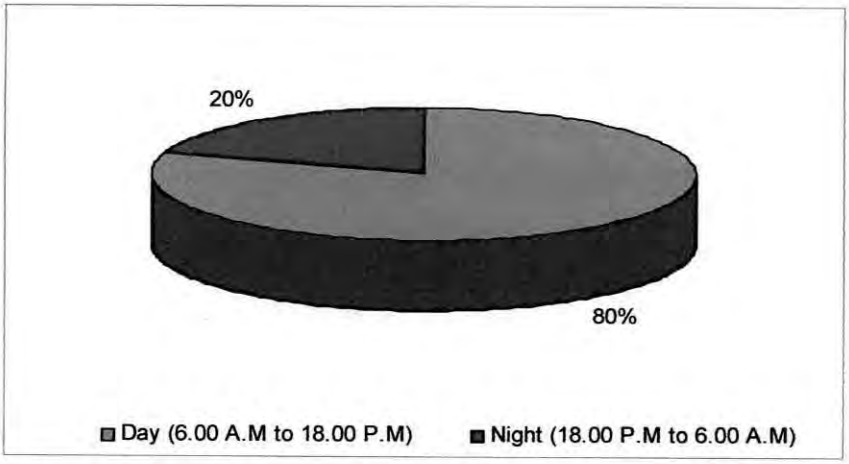


Figure 6.8: Accident Based on Day and Night at Itakhola

From analysis of selected black spot Itakhola in figure 6.8, it is observed that out of five accidents, four accidents are occurred during fresh day light period and another accident is occurred at night during the study three years period.

Description at Itakhola Black Spot

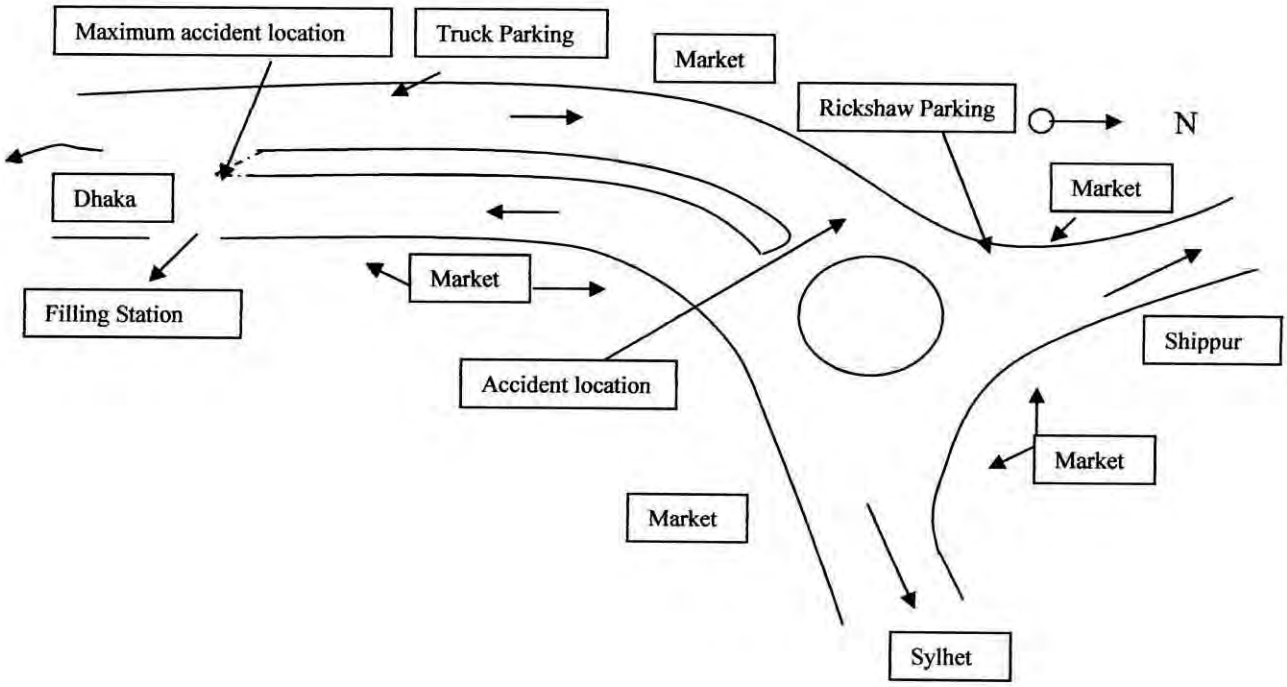
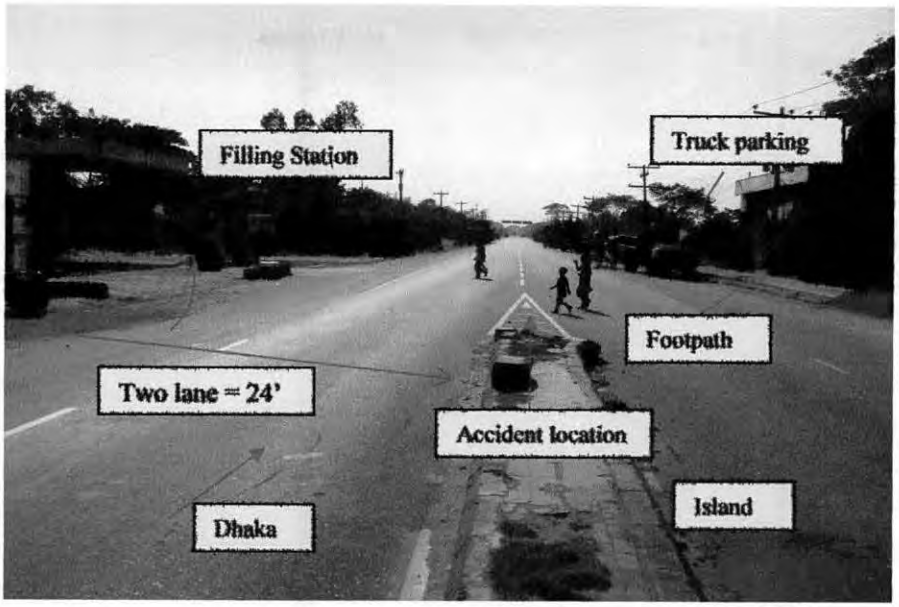
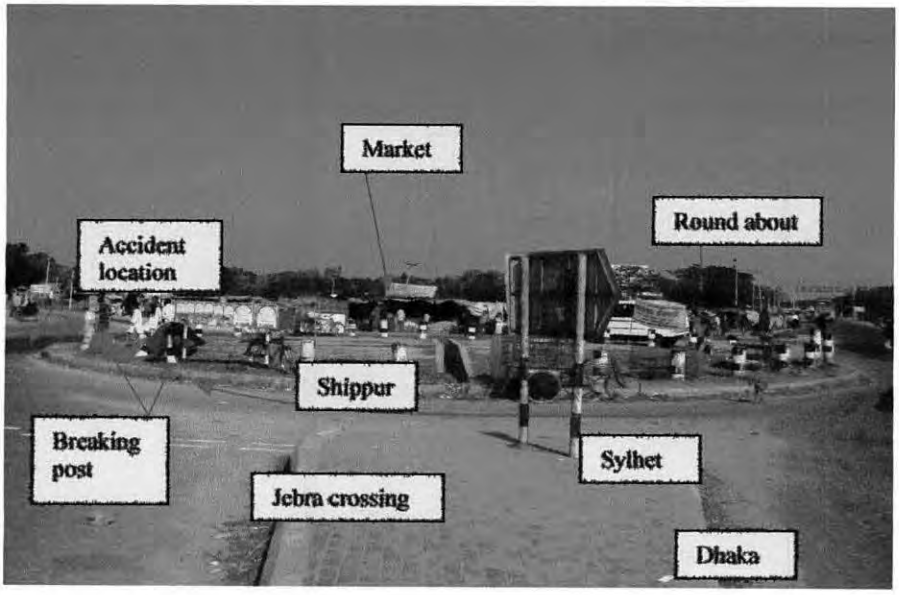


Figure 6.9: Layouts at Itakhola Black Spot. (Not in scale).

This selected black spot is located on Dhaka-Sylhet national highway at Itakhola place in Mounsheferchar village, Shippur thana and Narsingdi district. This spot is also a large market area. The highway is a horizontal curve at this selected black spot. In front of filling station maximum accident is occurred due to road divider. Truck parking is found here and there on the main highway, for which effective road width become too narrow. After 50m of filling station towards Sylhet a round about is located where three roads coincide with each other. One road comes from Dhaka, another one comes from Sylhet and last road comes from Shippur Thana.



Photograph 6.5: Maximum Accident Location at Itakhola



Photograph 6.6: Roundabout at Itakhola, Mounsheferchar

Mixed traffic with slow moving vehicle is found in this spot. No restriction of parking in this spot. Mixed traffic is found to stop for passengers around the round about. In this spot, the road is in four lanes. The road divider starts from the front of filling station and ends to the round about.

Probable Causes of Accidents at Itakhola Black Spot

When vehicle come from Dhaka in front of filling station, the drivers are not prepared for a sudden road divider. For this, vehicle hit the road divider and ultimate result is an accident. Maximum trucks are found in parking on the main approach road. For this reason effective width of the road decreased. No warning sign is available to alert coming vehicle from Dhaka end for sudden road divider. On Shippur road, at the corner of round about, slow moving rickshaws are parked for passengers who come several times too close to the round about. When vehicles come from Dhaka end and negotiate in the curve path around round about sometimes there arise a possibility to hit the local vehicles of small bus, tempo, minibus which stand around the round about for passengers such as rear end collision. No speed restriction warning post at this location. Total section is a horizontal curve at this spot. No restriction or systematic way of vehicles parking.

Remedial Measures at Itakhola, Mounsheferchar Black Spot

A warning post for sudden road divider must be installed as urgent basis. Speed limit post or speed breaker should install before the filling station. Truck parking should be taken away to another available place instead on main approach. In no case, rickshaw and other slow moving vehicles allow on main approach road. Small bus should not allow for standing on main approach around round about and a separate bus bays should be constructed. Segregate road crossing must control due to install proper traffic control system. Installing of access control system in between filling station to round about for restrict pedestrian free crossing tendency.

6.4.4 Study on Kundarpara Black Spot

This selected black spot is located at km. post 60 on Dhaka-Sylhet national highway at Kundarpara station, Chinispur village and Basail union. At this black spot total five accidents are occurred during the year from 2004 to 2006 where four accidents are fatal type and another accident is grievous type. As this spot satisfies partly the criteria of RHD black spot definition and fully satisfies the priority value fifteen with other available black spot definitions applied for other countries, so this spot is identified as an accident black spot for study.

Table 6.7: Accident and Casualties at Kundarpara Black Spot

Time	Total Accidents	Vehicles involved	Casualties			
			Fatal	Grievous	Simple	Total
12.00 A.M-1.59 A.M	0	0	0	0	0	0
2.00 A.M-3.59 A.M	0	0	0	0	0	0
4.00 A.M-5.59 A.M	2	3	2	0	0	2
6.00 A.M-7.59 A.M	0	0	0	0	0	0
8.00 A.M-9.59 A.M	0	0	0	0	0	0
10.00 A.M-11.59 A.M	1	1	1	0	0	1
12.00 P.M-13.59 P.M	0	0	0	0	0	0
14.00 P.M-15.59 P.M	0	0	0	0	0	0
16.00 P.M-17.59 P.M	1	1	0	1	0	1
18.00 P.M-19.59 P.M	0	0	0	0	0	0
20.00 P.M-21.59 P.M	1	1	1	0	0	1
22.00 P.M-23.59 P.M	0	0	0	0	0	0
Total	5	6	4	1	0	5

Source: Accident Research Institute (ARI), BUET, 2007, Dhaka-1000

From the analysis of accident distribution in bar diagram 6.10, it is observed that maximum accidents are occurred between 4.00 A.M to 6.00 A.M. Maximum vehicles are also involved during this period. Fatal accidents are occurred more during this period. Similarly during other mentioned period fatal and grievous types of accidents are occurred during these study years. Out of these mentioned periods no accident is occurred at this selected black spot of Kundarpara.

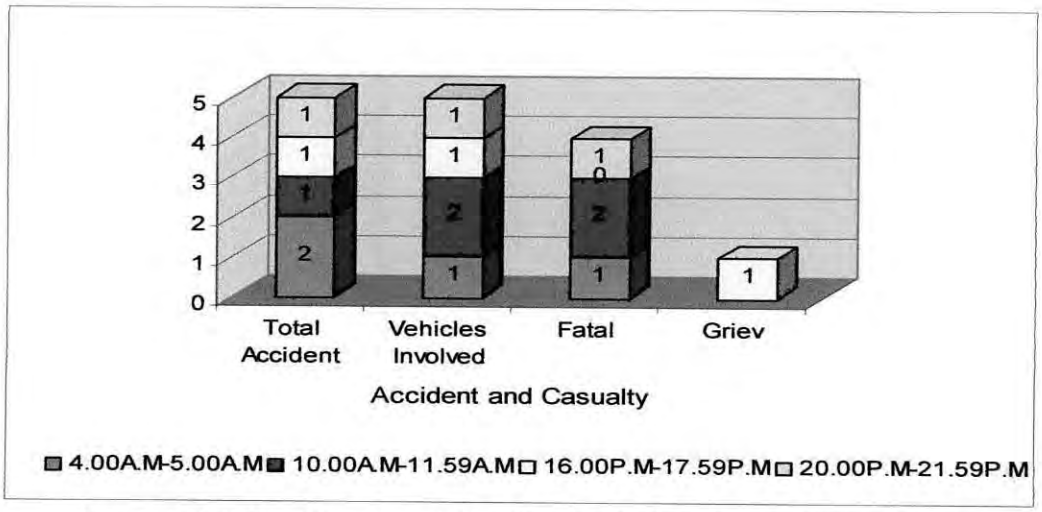


Figure 6.10: Bar Diagram of Accident Distribution at Kundarpara

Table 6.8: Accident Severity based on Weather at Kundarpara

Weather	Fatal	Grievous.	Simple.	Total
Fair	4	1	0	5
Rain	0	0	0	0
Wind	0	0	0	0
Fog	0	0	0	0
Total	4	0	0	5

Source: Accident Research Institute (ARI) BUET, 2007, Dhaka-1000

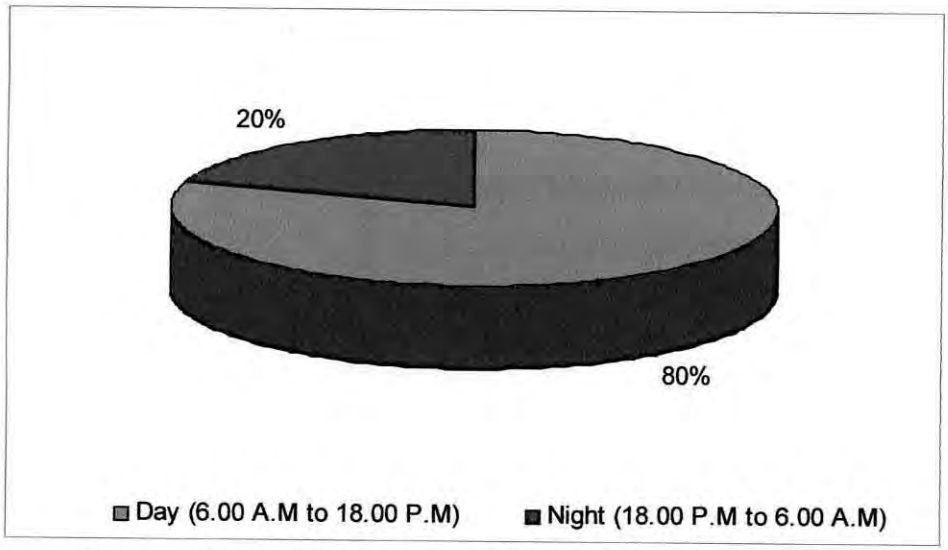


Figure 6.11: Accident Based on Day and Night at Kundarpara

From the analysis of table 6.8 for Kundarpara, Chinispur, Basail black spot, it is observed that all accident which are caused in this spot at a normal weather condition. During these three years 2004 to 2006 no accident is observed at the adverse rain, wind, foggy climate. Out of five accidents, four accidents are fatal types and another one is grievous types of accident.

From another analysis based on day and night, it is observed that maximum 80% accidents are occurred at day time in this selected black spot during the study period. At night, only one accident is occurred. Day time is more risky in this selected spot over night due to local traffic congestion and tendency more to cross the main highway.

Description at Kundarpara Black Spot

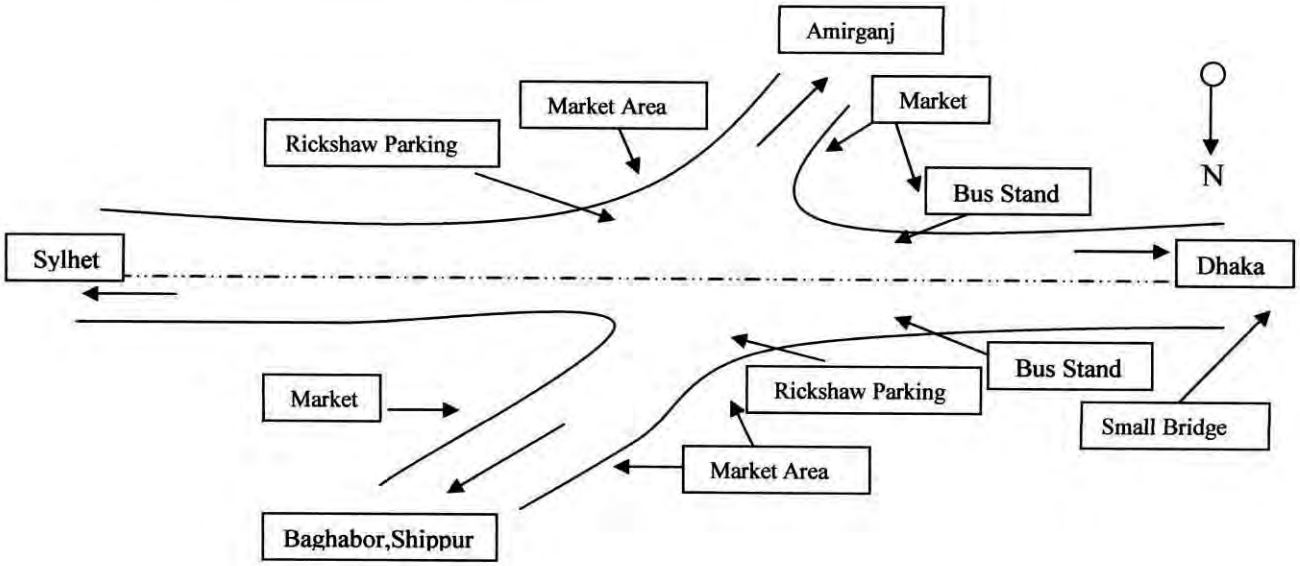
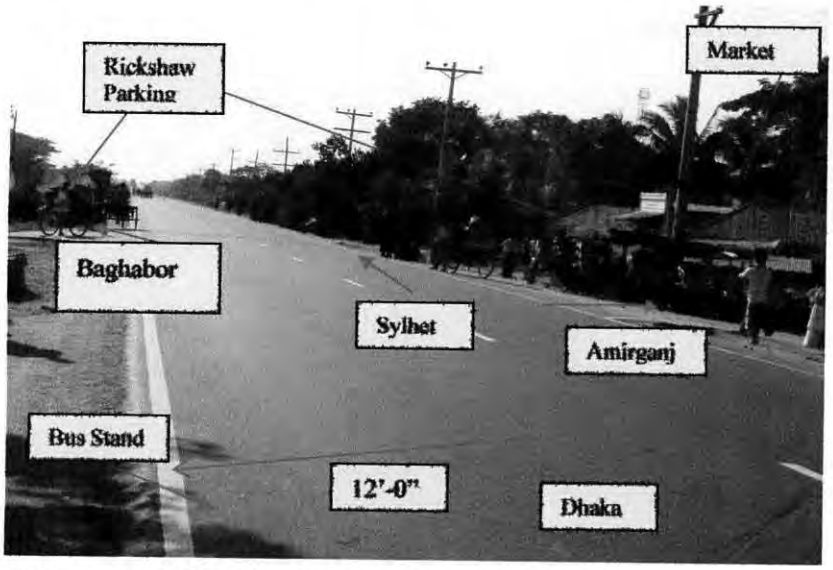


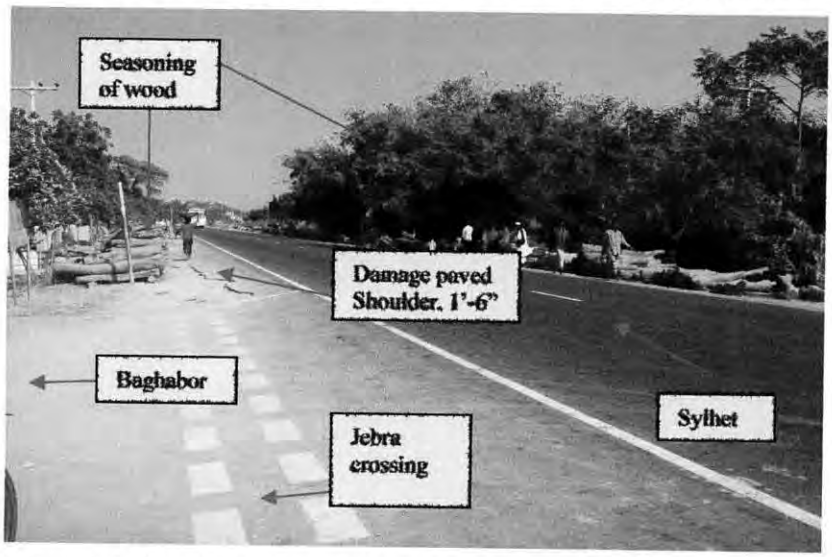
Figure 6.12: Layouts at Kundarpara Black Spot (not in scale).

This black spot is located on Dhaka-Sylhet national highway at Kundarpara spot, Chinispur, Basail in Shippur thana, Narsingdi district. This spot is also an intersection. Two roads are joined with main highway from two sides. One side road connects Amirganj and another road connects Baghabor of Shippur thana with the main Highway.

The spot is a busy village market area. A sharp vertical curve (bridge) is first found from Dhaka end, and then the spot is located nearly 300m ahead from the bridge. Two rickshaw stands are also found at very adjacent or on both side of main highway at this spot. Mixed traffic is found in this black spot. Woods are placed on soft shoulder for a long time in this spot for seasoning. Small bus, tempo etc stand on this spot both side for passengers. Width of main approach road is 24'-0", hard shoulder width 4'-0" and soft shoulder width 9'-6". The national highway is in two lanes here.



Photograph 6.7: Kundarpara intersection, Chinispur, Basail



Photograph 6.8: Shoulder and crossing at Kundarpara Black Spot

Probable Causes of Accidents at Kundarpara Black Spot

Large sharp vertical curve (bridge) is found before the intersection. For this the driver coming from Dhaka end with a high speed does not get enough time for alert due to insufficient sight distance at this location. Slow moving vehicles are crossing the main highway independently in this spot. As this is a market area, people are crossed in this spot freely No speed restriction sign is found at this black spot. Mixed traffic is also another problem which cause of accident. No access control engineering device is found in this black spot. Slow moving rickshaw parking is at the adjacent of main approach road is common scenario at this spot.

Remedial Measures at Kundarpara Black Spot

Warning sign for intersection on both sides of Dhaka and Sylhet end at this black spot must be installed immediately especially before bridge at Dhaka end. Speed restriction post should be installed at this spot. Speed breaker may be constructed for slow movement in this busy market area. In no condition slow moving vehicles such as rickshaw, van should not allow to stand or cross the main highway. Wood should be taken away to make free the soft shoulder in this spot because it causes an obstacle when drivers traveling through this black spot. Stopping time of small bus or other local vehicle should be reduced on this bus stand. Rickshaw parking should be taken away from main approach road to the inside of side road at this location.

6.4.5 Study on Hajibagh Black Spot

This selected black spot is located at km. post 65 on Dhaka-Sylhet national highway at Hajibagh station, Sristighor village and Chaitanna union. At this black spot total four accidents are occurred during the year in 2004 to 2006 where three accidents are fatal type and one accident is grievous type. As this selected spot satisfies partly the criteria of RHD black spot definition and fully satisfies the priority value fifteen with other available black spot definitions applied for other countries, so this spot is also identified as an accident black spot on Dhaka-Sylhet national highway.

Table 6.9: Accident and Casualties at Hajibagh Black Spot.

Time	Total Accidents	Vehicles involved	Casualties			
			Fatal	Grievous	Simple	Total
12.00 A.M-1.59 A.M	0	0	0	0	0	0
2.00 A.M-3.59 A.M	0	0	0	0	0	0
4.00 A.M-5.59 A.M	0	0	0	0	0	0
6.00 A.M-7.59 A.M	0	0	0	0	0	0
8.00 A.M-9.59 A.M	0	0	0	0	0	0
10.00 A.M-11.59 A.M	1	2	0	2	0	2
12.00 P.M-13.59 P.M	0	0	0	0	0	0
14.00 P.M-15.59 P.M	2	2	2	0	0	2
16.00 P.M-17.59 P.M	1	1	1	0	0	1
18.00 P.M-19.59 P.M	0	0	0	0	0	0
20.00 P.M-21.59 P.M	0	0	0	0	0	0
22.00 P.M-23.59 P.M	0	0	0	0	0	0
Total	4	5	3	2	0	5

Source: Accident Research Institute (ARI), BUET, 2007, Dhaka-1000

From the analysis of data table 6.9 and accident distribution bar diagram 6.12 of this selected black spot it is observed that maximum accidents are fatal types which are occurred between 14.00 P.M to 16.00 P.M. Maximum vehicles are involved during this period. Fatal accidents are also observed more on this period. Similarly grievous and other types of accidents are occurred in the other mentioned period 10.00A.M to 12.00 P.M and 16.00 P.M to 18.00 P.M. Out of these mentioned periods no accident is observed at this selected black spot during the study period of 2004 to 2006.

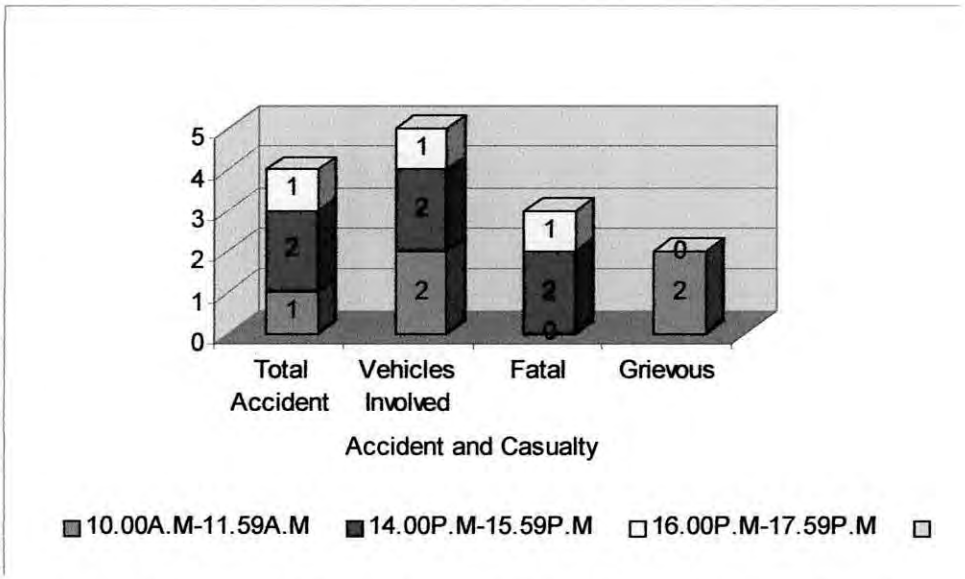


Figure 6.12: Bar Diagram of Accident Distribution at Hajibagh.

Table 6.10: Accident Severity Based on Weather at Hajibagh.

Weather	Fatal	Grievous.	Simple.	Total
Fair	3	1	0	4
Rain	0	0	0	0
Wind	0	0	0	0
Fog	0	0	0	0
Total	3	1	0	4

Source: Accident Research Institute (ARI),BUET, 2007, Dhaka-1000

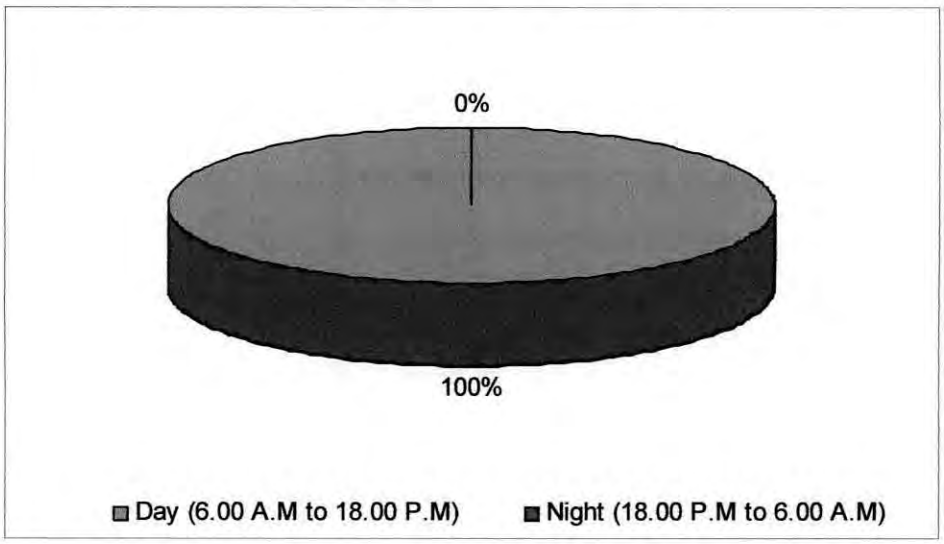


Figure 6.13: Accident Based on Day and Night at Hajibagh.

From the analysis of data table 6.10 in study three years period, it is observed that all accidents are caused in this spot are at a normal weather condition. In the last three years 2004 to 2006 no accident is occurred during the adverse climate such as rain, wind and fog. Out of four accidents, three accidents are fatal types and another one is grievous types at this selected black spot

From another analysis based on day and night in figure 6.13, it is observed that all accidents are occurred at day time on this selected black spot during three years study period. At night, no accident is observed. Day time is more risky at this selected spot than night because sometimes drivers are fail to stop the vehicle due to presence of sudden sharp horizontal curve.

Description at Hajibagh Black Spot

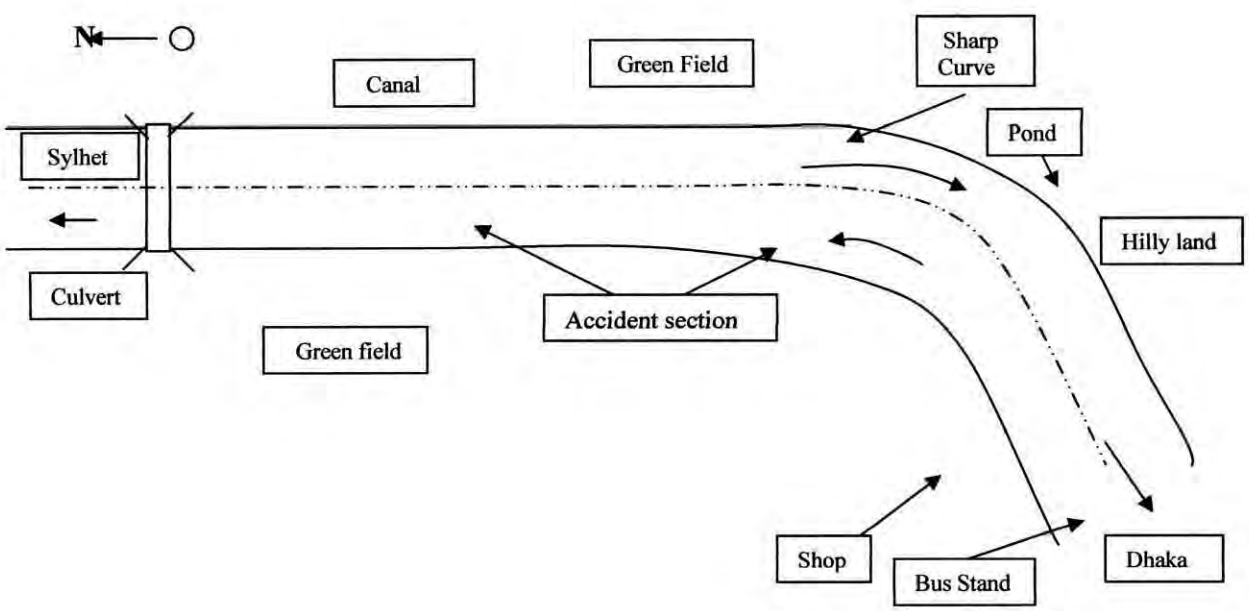
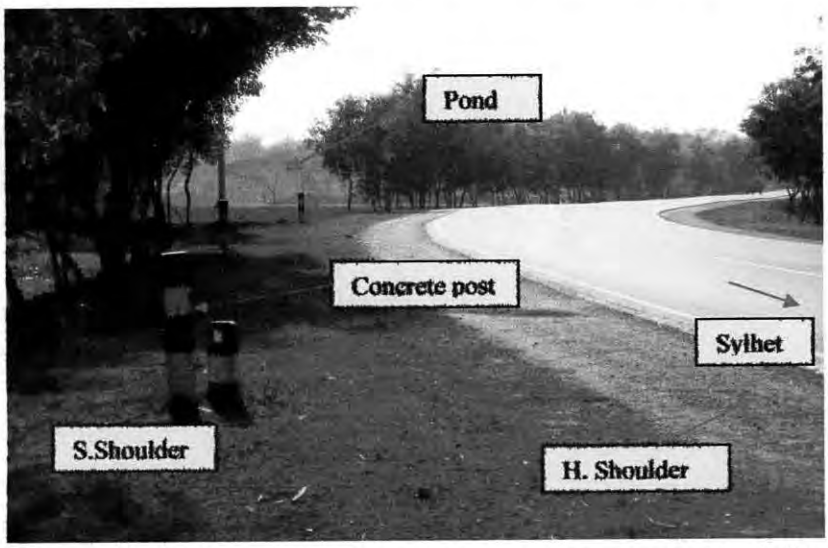


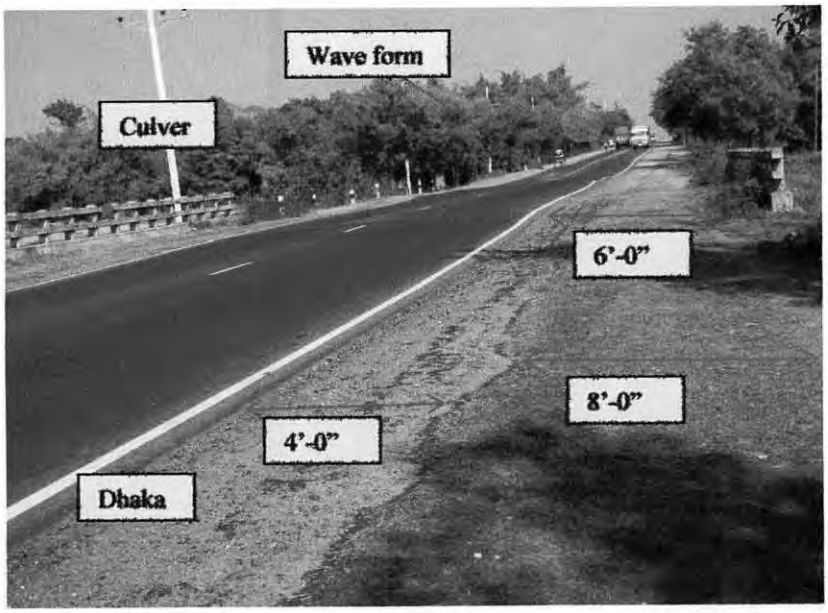
Figure 6.14: Layouts at Hajibagh Black Spot. (not in scale).

This black spot is located on Dhaka-Sylhet national highway at Hajibagh station. Accidents are caused with in a section between Hajibagh bus stand and a Culvert which is approximately 200m ahead towards Sylhet direction. Small bus and tempo stand in this

black spot for passengers. In this selected black spot, a very sharp horizontal curve is found. This curve is located after this Hajibagh bus stand around 200m apart towards Sylhet direction. A culvert is also found in this spot in where accidents were occurred in between culvert and bus station. Vehicles are traveled in this spot with a very high speed and negotiate a sharp curve in where sight distance was not adequate. The highway in this black spot is in two lanes. The main approach width is 24'-0", hard shoulder width is 4'-0" and soft shoulder width is 8'-0", H. Shoulder at culvert location 6'-0".



Photograph 6.9: Sharp Horizontal Curve at Hajibagh Black Spot.



Photograph 6.10: Culvert Location at Hajibagh Black Spot.

Probable Causes of Accidents at Hajibagh Black Spot

In this Black Spot a very sharp horizontal curve is found in between the segments of around 300m length. The vehicle speed in this location is too much high. Tendency of overtaking in is spot is a common scenario though a very sharp curve is at this site. Vehicle coming from Sylhet travel a very long straight path and suddenly face sharp curve without any prior information of this spot. No speed limit sign post or any warning post was not found.

Remedial Measures at Hajibagh Black Spot

Speed limit sign post should be installed from two ends of Dhaka and Sylhet of this section. A warning post mentioning the sharp curve should be installed in urgent basis on both side of this spot. Breaking of concrete post should be installed again. Not overtaking sign post should be also installed before culvert as driver coming from Sylhet end can get prior idea about this spot.

Study on Baraicha Black Spot

This black spot is located at km. post 78 on Dhaka-Sylhet national highway at Baraicha station, Narayanpur village, Khajurtala union and Bleabo thana. On this black spot total four accidents are occurred during year 2004 to 2006. Out of four accidents, three accidents are fatal type and one accident is grievous type. As this spot satisfies partly the criteria of RHD black spot definition and fully satisfies the priority value fifteen and other existing black spot definitions of deferent countries, so this spot is identified as an accident black spot for this study.

Table 6.11: Accident and Casualties at Baraicha Black Spot.

Time	Total Accidents	Vehicles involved	Casualties			
			Fatal	Grievous	Simple	Total
12.00 A.M-1.59 A.M	0	0	0	0	0	0
2.00 A.M-3.59 A.M	0	0	0	0	0	0
4.00 A.M-5.59 A.M	1	1	1	0	0	1
6.00 A.M-7.59 A.M	1	1	0	1	0	1
8.00 A.M-9.59 A.M	0	0	0	0	0	0
10.00 A.M-11.59 A.M	0	0	0	0	0	0
12.00 P.M-13.59 P.M	1	1	1	1	0	2
14.00 P.M-15.59 P.M	1	1	1	0	0	1
16.00 P.M-17.59 P.M	0	0	0	0	0	0
18.00 P.M-19.59 P.M	0	0	0	0	0	0
20.00 P.M-21.59 P.M	0	0	0	0	0	0
22.00 P.M-23.59 P.M	0	0	0	0	0	0
Total	4	4	3	2	0	5

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

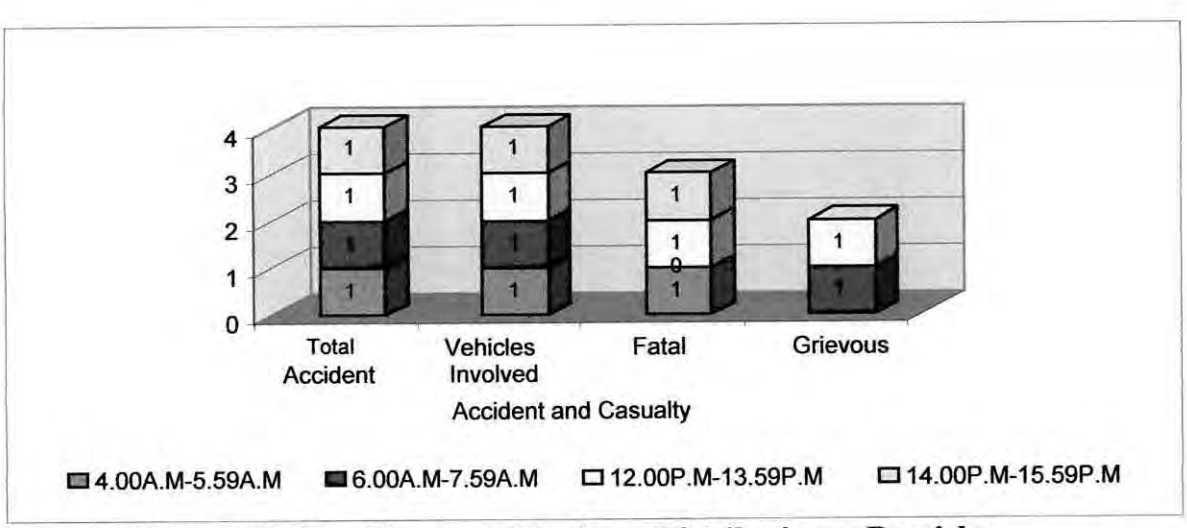


Figure 6.15: Bar Diagram of Accident Distribution at Baraicha.

From the analysis of accident data table 6.11 and accident distribution bar diagram in figure 6.15, it is observed that maximum accidents are fatal types. Majority number of accidents is occurred during 12.00 P.M to 6.00 A.M. In each accident single number of vehicle is involved. Two grievous type of accident is occurred during 6.00 A.M to 14.00 P.M. Out of these mentioned periods, no accident is observed on this black spot form 2004 to 2006 on Dhaka-Sylhet national highway.

Table 6.12: Accident Severity Based on Weather at Baraicha.

Weather	Severity				
	Fatal	Grievous	Simple	Collision	Total
Fair	3	1	0	0	4
Rain	0	0	0	0	0
Wind	0	0	0	0	0
Fog	0	0	0	0	0
Total	3	1	0	0	4

Source: Accident Research (ARI), 2007, BUET, Dhaka-1000

From the analysis of data table 6.12, it is observed clearly that all accident on this selected black spot is occurred at normal weather condition. During last three years no accident is occurred during adverse rain, wind or foggy climate. Out of four accidents, three accidents are fatal types and another one accident is grievous type accident on this selected black spot on Dhaka-Sylhet national highway.

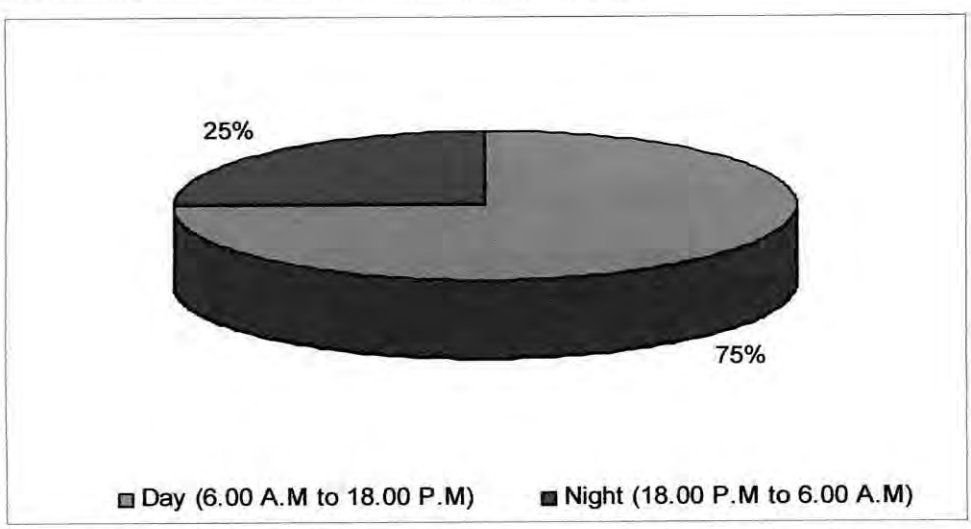


Figure 6.16: Accident Based on Day and Night at Baraicha

From analysis based on day and night in figure 6.16, it is observed that about three-fourth of total accidents are occurred during day in fine weather condition at this black spot in study three years period on Dhaka-Sylhet national highway.

Study on Bhelanagar Black Spot

This selected black spot is located at km. post 53 named Bhelanagar station on Kararchar area. At this selected black spot, total eight accidents are occurred during year 2001 to 2003. Out of eight accidents, four accidents are fatal type and three accidents are grievous type. As this selected spot satisfies partly the criteria of RHD black spot definition and fully satisfies priority value fifteen with other available black spot definitions applied for black spot selection in other developed countries, so this spot is identified as an accident black spot for this study on Dhaka-Sylhet national highway.

Table 6.13: Accident and Casualties at Bhelanagar Black Spot

Time	Total Accidents	Vehicles involved	Casualties			
			Fatal	Grievous	Simple	Total
12.00 A.M-1.59 A.M	0	0	0	0	0	0
2.00 A.M-3.59 A.M	0	0	0	0	0	0
4.00 A.M-5.59 A.M	0	0	0	0	0	0
6.00 A.M-7.59 A.M	1	2	0	2	1	3
8.00 A.M-9.59 A.M	3	4	2	2	0	4
10.00 A.M-11.59 A.M	1	1	1	0	0	1
12.00 P.M-13.59 P.M	0	0	0	0	0	0
14.00 P.M-15.59 P.M	0	0	0	0	0	0
16.00 P.M-17.59 P.M	3	3	2	1	0	3
18.00 P.M-19.59 P.M	0	0	0	0	0	0
20.00 P.M-21.59 P.M	0	0	0	0	0	0
22.00 P.M-23.59 P.M	0	0	0	0	0	0
Total	8	10	5	5	1	11

Source: Accident Research (ARI), 2007, BUET, Dhaka-1000

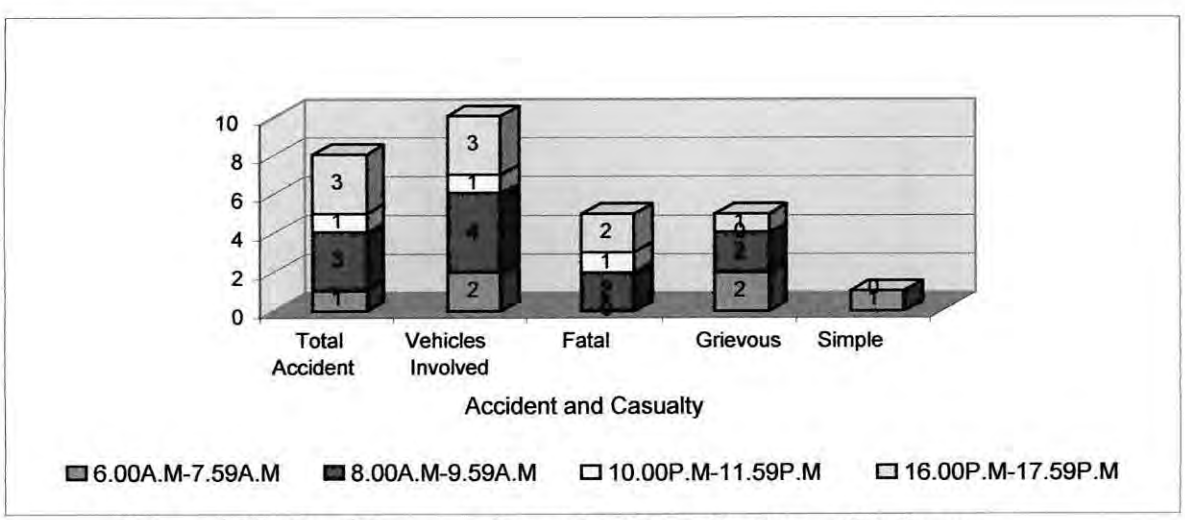


Figure 6.17: Bar Diagram of Accident Distribution at Bhelanagar.

From the analysis of accident data table 6.13 and accident distribution bar diagram 6.17, it is observed that maximum accidents are fatal types, out of which three accidents occurred and four vehicles are involved in between times 8.00 A.M to 10.00 A.M. Two persons are died and two persons are seriously injured in this period. It is also exposed that between 16.00 P.M to 18.00 P.M, three accidents are occurred where three vehicles are involved. Two persons are died and two persons are seriously injured during this study period of accident. Except this time, between 6.00 A.M to 8.00 A.M one accident is occurred where two vehicles are involved and two persons are serious injured and one person is normally injured.

Table 6.14: Accident Severity Based on Weather at Bhelanagar

Weather	Severity				
	Fatal	Grievous.	Simple	Collision	Total
Fair	4	4	0	0	8
Rain	0	0	0	0	0
Wind	0	0	0	0	0
Fog	0	0	0	0	0
Total	4	4	0	0	8

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

From the analysis of data table 6.14 based on weather condition during study period of three years on this selected black spot, it is observed that all accidents are occurred in fair weather. Out of eight accidents, four accidents are fatal type and another four accidents are grievous type. No accident is observed in adverse rainy condition or in wind. From another analysis based on day and night it is shown that all eight accidents are occurred at day in this selected black spot during the study period 2001 to 2003.

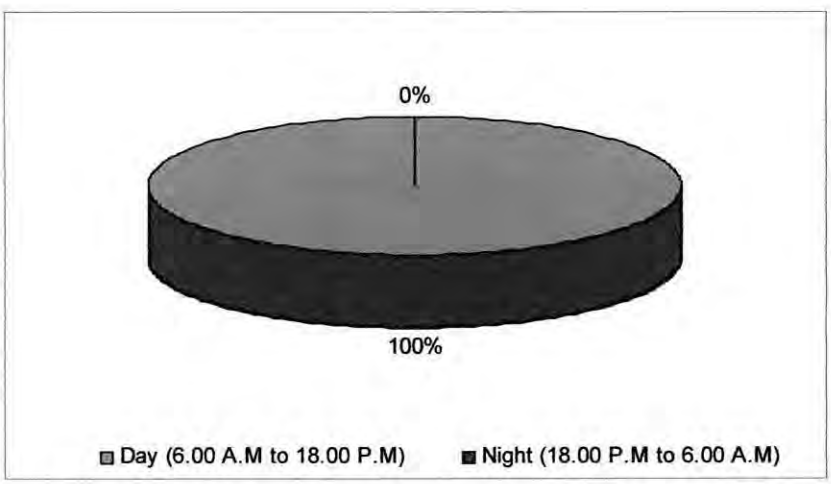


Figure 6.18: Accident Based on Day and Night at Bhelanagar.

Study on Surama Tea Garden Black Spot

This selected black spot is located at km. post 129 in front of gate number seven named Surma Tea Garden at Habiganj district on Dhaka-Sylhet national highway. At this black spot total three accidents are occurred during year 2001 to 2003. All accidents are fatal types. As this spot satisfies partly the criteria of RHD black spot definition and fully satisfies the priority value fifteen as well as available black spot definitions which are applied for other countries, so this selected spot is also identified as an accident black spot for this study.

Table 6.15: Accident and Casualties at Surma Tea Garden

Time	Total Accidents	Vehicles involved	Casualties			
			Fatal	Grievous	Simple	Total
12.00 A.M-1.59 A.M	0	0	0	0	0	0
2.00 A.M-3.59 A.M	0	0	0	0	0	0
4.00 A.M-5.59 A.M	0	0	0	0	0	0
6.00 A.M-7.59 A.M	0	0	0	0	0	0
8.00 A.M-9.59 A.M	0	0	0	0	0	0
10.00 A.M-11.59 A.M	0	0	0	0	0	0
12.00 P.M-13.59 P.M	0	0	0	0	0	0
14.00 P.M-15.59 P.M	1	2	3	12	0	15
16.00 P.M-17.59 P.M	0	0	0	0	0	0
18.00 P.M-19.59 P.M	2	4	2	0	0	2
20.00 P.M-21.59 P.M	0	0	0	0	0	0
22.00 P.M-23.59 P.M	0	0	0	0	0	0
Total	3	6	5	12	0	17

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

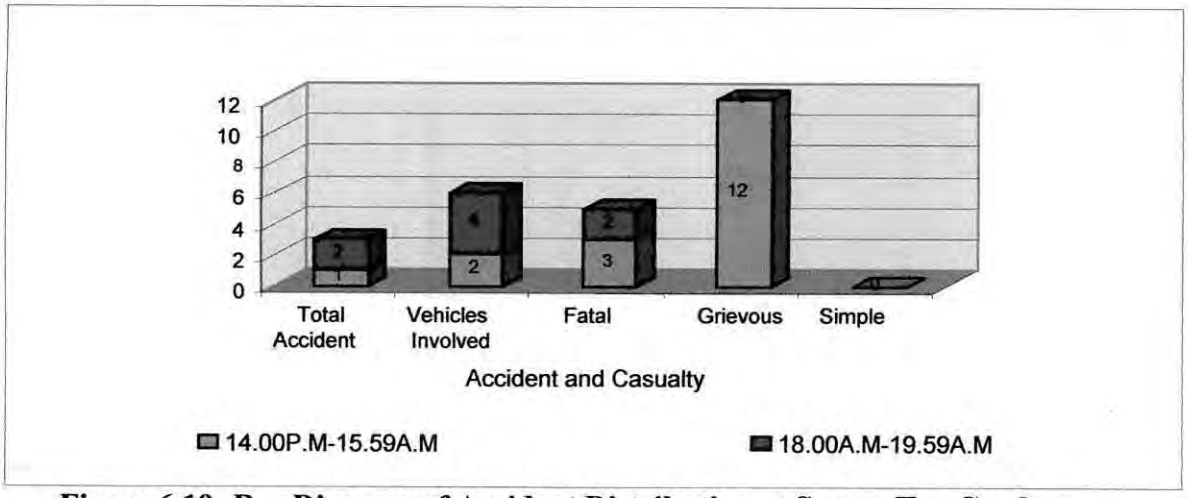


Figure 6.19: Bar Diagram of Accident Distribution at Surma Tea Garden.

From the analysis of data table 6.15 and accident distribution in bar diagram from figure 6.19, it is observed that two accidents are occurred where four vehicles are involved between 14.00 P.M to 16.00 P.M. Two persons are died during this mentioned period. It is also observed that during period 14.00 P.M to 16.00 P.M another accident is occurred at this selected black spot where two vehicles are involved and three persons are died for this accident. Twelve persons are also seriously injured by this accident. Out of these mentioned periods no accident is observed at this spot.

Table 6.16: Accident Severity Based on Weather at Surma Tea Garden.

Weather	Severity				
	Fatal	Grievous.	Simple	Collision	Total
Fair	2	0	0	0	2
Rain	0	0	0	0	0
Wind	0	0	0	0	0
Fog	1	0	0	0	1
Total	3	0	0	0	3

Source: Accident Research Institute (ARI), 20007, BUET, Dhaka-1000

From the analysis of data table 6.16, based on weather condition during study period of three years, it is observed that all accidents are fatal types where two accidents are occurred in normal weather and another one is in foggy climate. No accident is observed in rainy and wind climate at this selected black spot.

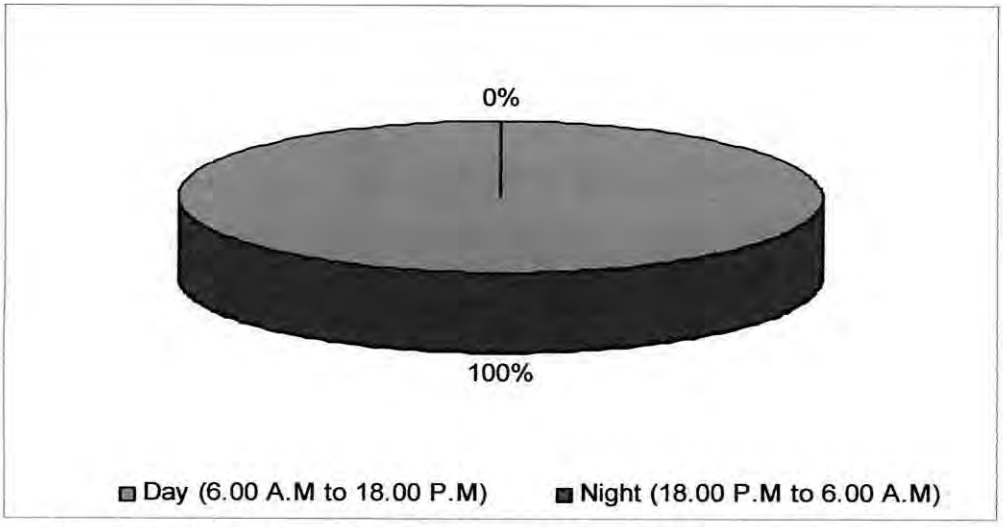


Figure 6.20: Accident Based on Day and Night, Surma Tea Garden

From figure 6.20, it is observed that all accidents are occurred during day at this selected black spot during the study period of 2001 to 2003. No accident is observed during night at this selected black spot on Dhaka-Sylhet national highway.

Study on Natun bazaar Black Spot.

This black spot is located at km. post 147 to 148 on Natun bazaar station, Barailgram village, Shaestagonj union and Chunarughat thana on Dhaka – Sylhet national highway. At this black spot, total five accidents are occurred during year 2001 to 2003 where three accidents are fatal types, one accident is grievous type and another accident is collision types. As this selected spot satisfies partly the criteria of RHD black spot definition and fully satisfies the priority value fifteen with other available black spot definitions applied for other countries, so this spot is also identified as an accident black spot for this study.

Table 6.17: Accident and Casualties at Natun Bazaar Black Spot

Time	Total Accidents	Vehicles involved	Casualties			
			Fatal	Grievous	Simple	Total
12.00 A.M-1.59 A.M	0	0	0	0	0	0
2.00 A.M-3.59 A.M	0	0	0	0	0	0
4.00 A.M-5.59 A.M	1	1	1	0	0	1
6.00 A.M-7.59 A.M	0	0	0	0	0	0
8.00 A.M-9.59 A.M	1	1	1	0	0	1
10.00 A.M-11.59 A.M	0	0	0	0	0	0
12.00 P.M-13.59 P.M	2	2	1	0	3	4
14.00 P.M-15.59 P.M	0	0	0	0	0	0
16.00 P.M-17.59 P.M	1	1	0	1	0	1
18.00 P.M-19.59 P.M	0	0	0	0	0	0
20.00 P.M-21.59 P.M	0	0	0	0	0	0
22.00 P.M-23.59 P.M	0	0	0	0	0	0
Total	5	5	3	1	3	7

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

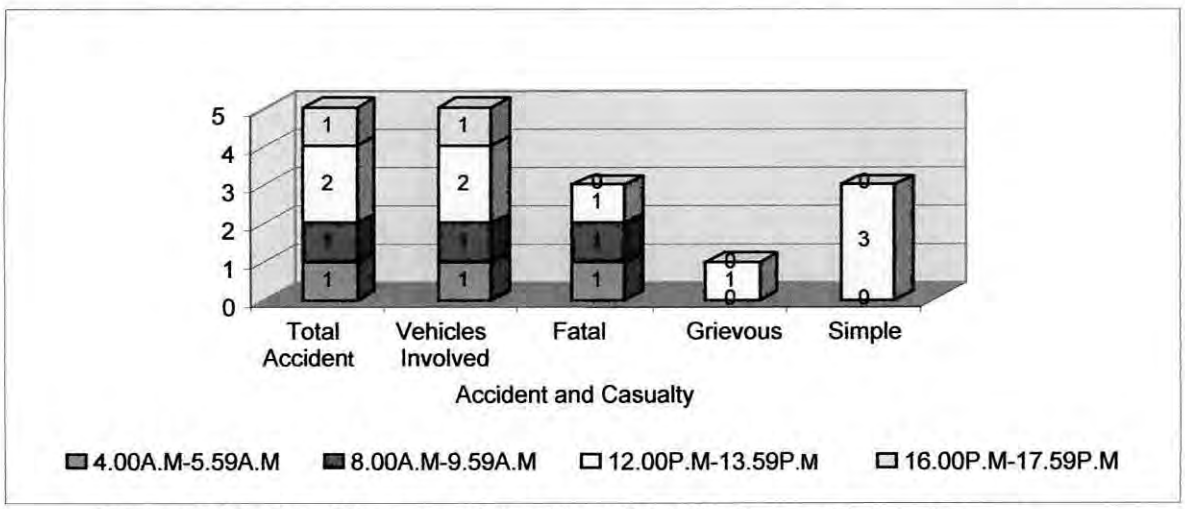


Figure 6.21: Bar Diagram of Accident Distribution at Natun Bazaar.

From figure 6.21, accident distribution bar diagram for black spot reveals that at Natun Bazaar station, two accidents are occurred where two vehicles are involved between 12.00 P.M to 14.00 P.M. One person is died and one person is seriously injured for this accident. Three persons are also normally injured during this mentioned period. During 4.00A.M to 9.00A.M, other two accidents are occurred where one person is died by this time at this selected black spot during this study period of 2001 to 2003.

Table 6.18: Accident Severity Based on Weather at Natun Bazaar.

Weather	Severity				
	Fatal	Grievous.	Simple	Collision	Total
Fair	3	0	1	0	4
Rain	0	1	0	0	1
Wind	0	0	0	0	0
Fog	0	0	0	0	0
Total	3	1	1	0	5

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

From the analysis of data table 6.18 in study period of three years on this selected black spot, it is also revealed that out of five accidents, three accidents are fatal types which are observed at normal weather condition. One accident is grievous type which is observed in rainy condition. Another accident is simple type which is also observed in normal weather condition at this selected black spot on Dhaka-Sylhet highway.

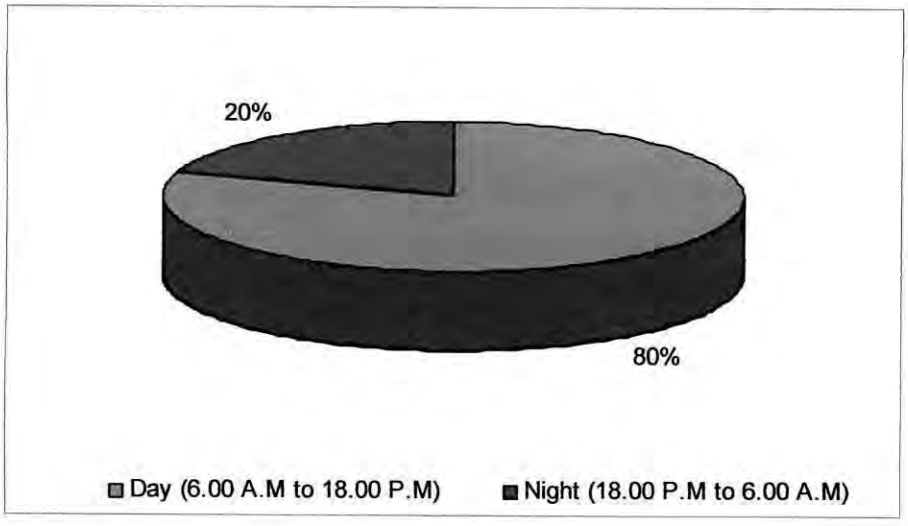


Figure 6.22: Accident Based on Day and Night at Natun Bazaar.

From the analysis based on day and night in figure 6.22, it is observed that four-fifth accidents are occurred at this black spot during day time and rest one accident is occurred at night during the whole study period on this selected black spot.

Study on Chunarughat Bazaar Black Spot.

This black spot is located at km. post 150 to 151 on Chunarughat Thana Bazaar, Rice Mill area near Chunarughat union parishad office at Amtali tea garden on Dhaka-Sylhet national highway. At this black spot, total five accidents are occurred during the year 2001 to 2003. Out of these accidents, three accidents are fatal and one accident is grievous type. As this spot satisfies partly satisfies the criteria of RHD black spot definition and fully satisfies the priority value fifteen with other available black spot definitions applied for other countries, so this selected spot is also identified as an accident black spot for this study on Dhaka-Sylhet national highway.

Table 6.19: Accident and Casualties at Chunarughat Bazaar

Time	Total Accidents	Vehicles involved	Casualties			
			Fatal	Grievous	Simple	Total
12.00 A.M-1.59 A.M	0	0	0	0	0	0
2.00 A.M-3.59 A.M	0	0	0	0	0	0
4.00 A.M-5.59 A.M	1	2	1	1	1	3
6.00 A.M-7.59 A.M	0	0	0	0	0	0
8.00 A.M-9.59 A.M	0	0	0	0	0	0
10.00 A.M-11.59 A.M	0	0	0	0	0	0
12.00 P.M-13.59 P.M	1	1	1	0	0	1
14.00 P.M-15.59 P.M	1	1	1	1	0	2
16.00 P.M-17.59 P.M	0	0	0	0	0	0
18.00 P.M-19.59 P.M	0	0	0	0	0	0
20.00 P.M-21.59 P.M	1	2	0	2	4	6
22.00 P.M-23.59 P.M	0	0	0	0	0	0
Total	4	6	3	4	5	12

Source: Accident Research Institute (ARI), 2007, BUET, Dhaka-1000

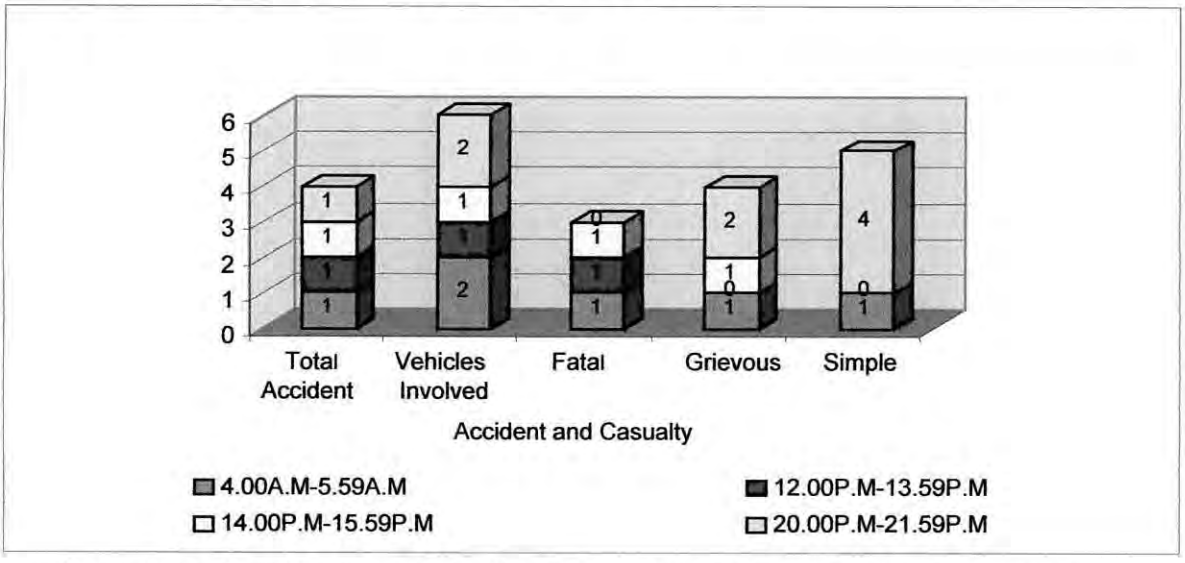


Figure 6.23: Bar Diagram of Accident Distribution at Chunarughat Bazaar.

From the analysis of data table 6.19 and accident distribution bar diagram 6.23 of black spot Chunarughat thana bazaar, it is observed clearly that maximum casualty due to accident is observed during 20.00 P.M to 22.00 P.M where two persons are seriously injured and four persons are normally injured due to a single accident. During 4.00 A.M to 6.00 A.M, one accident is observed where two vehicles are involved. One person is died, one person is seriously injured and another person is normally injured by this time. Beside this no accident is occurred in this spot during the study period.

Table 6.20: Accident Severity based on Weather at Chunarughat Bazaar.

Weather	Severity				
	Fatal	Grievous	Simple	Collision	Total
Fair	2	1	0	0	3
Rain	0	0	0	0	1
Wind	0	0	0	0	0
Fog	1	0	0	0	1
Total	3	1	0	0	4

Source: Accident Research Institute (ARI)), 2007, BUET, Dhaka-1000

From the analysis of data table 6.20 during study periods of three years at this selected black spot, it is observed that total four accidents are occurred. Three accidents are fatal types out of which two accidents are in fair weather condition and another one is occurred in foggy climate. Another grievous type accident is also observed during fair weather condition on this selected black spot on Dhaka-Sylhet national highway.

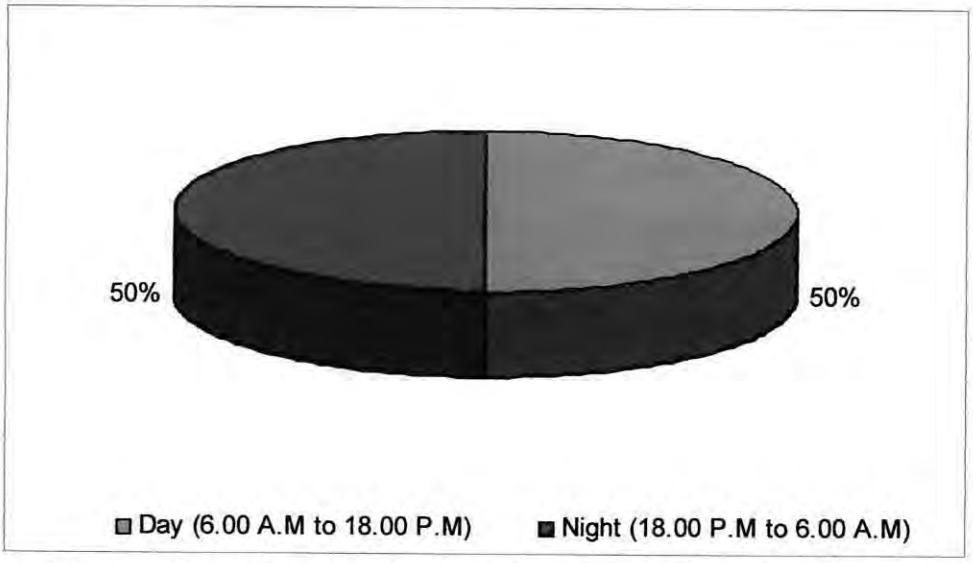


Figure 6.24: Accident Based on Day and Night at Chunarughat Thana Bazaar.

From analysis based on day and night in figure 6.24, it is observed that the ratio of accidents during day and night was almost same during the study period at this selected black spot which were occurred during 6.00 A.M to 18.00 P.M in day and 19.00 P.M to 6.00 P.M at night.

6.5 Comparative Black Spot Study

This study is conducted after collection of accident related data for three consecutive years on different black spots area among Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highway. This study makes comparison among two junctions and two nodes type black spots on this three study national highways.

6.5.1 Comparative Study among Site on Three National Highways

On Dhaka-Chittagong national highway, km. post 29.6 is placed subsequent to Gozaria bus stand. A village road meets with national highway on this site. On Dhaka-Sylhet national highway, km. post 57 is to be found on Baraitala area. On this spot, two side roads meet with this national highway. It is a market area. On Dhaka –Aricha national highway, km. post 25.6 is placed on Savar bazaar bus stand. This spot is busy with high traffic congestion. These three areas are considered as first selected site on three selected national highways.

Table 6.21: Comparative Accident Distribution on First Selected Site

National Highway	Dhaka-Chittagong				Dhaka-Sylhet		Dhaka-Aricha		
	Km. Post-29.6				Km. Post-57		Km. Post-25.6		
	2001 to 2003				2004 to 2004		2001 to 2003		
Collision Types	Fatal	Grievous	Simple	Total	Fatal	Total	Fatal	Grievous	Total
Head-on	-	1	-	1	1	1	-	-	-
Rear end	1	-	2	3	-	-	-	1	1
Overturn	1	-	-	1	1	1	-	-	-
Pedestrian	2	1	-	3	3	3	3	-	3
Road Side Object	-	-	1	1	-	-	-	-	-
Others	-	-	-	-	-	-	-	1	1
Total	4	2	3	9	5	5	3	2	5

Source: Accident Research Institute (ARI), 2008, BUET, Dhaka-1000

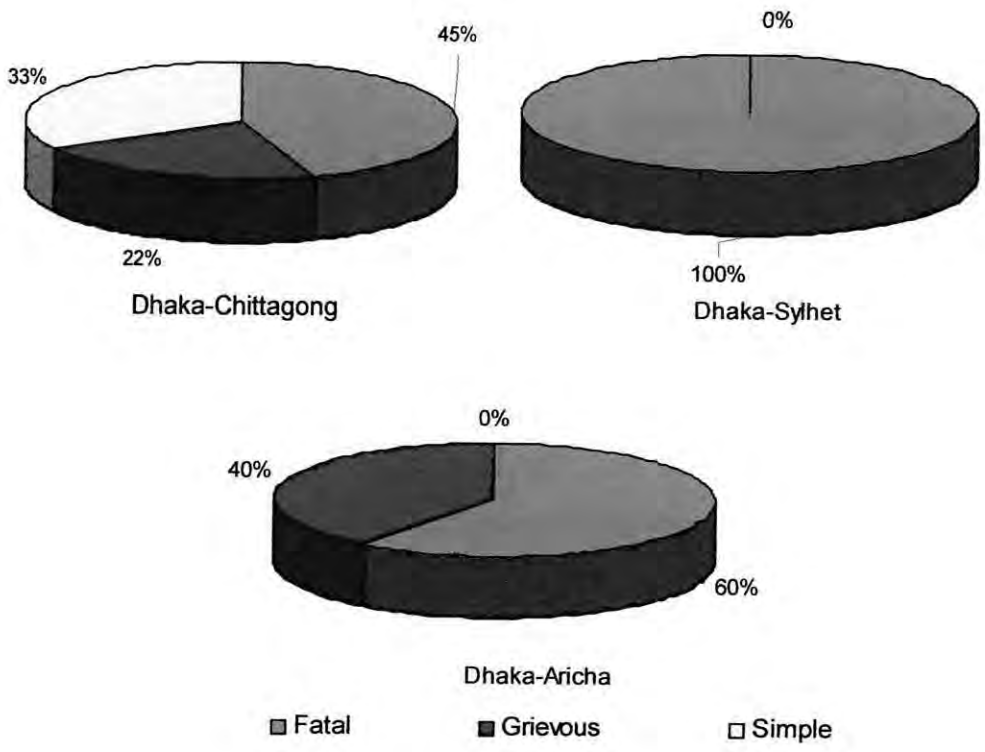


Figure 6.25: Comparative Accident Severity on First Selected Site

From analysis of table 6.21, it is observed evidently that maximum accidents are occurred on selected site of Dhaka-Chittagong national highway than other two national highways. Fatal accidents are found more on selected site at Dhaka-Sylhet national highway. Accident fatality on each selected site is comparatively more than other types of accident severities. Fatal accident on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways is found 45%, 100% and 60% of total accidents. Grievous accident is also occurred significantly on selected sites of Dhaka-Chittagong and Dhaka-Aricha national highways and it is observed 22% and 40% of total accident respectively.

From figure 6.26, it is observed that pedestrian collision type accidents are occurred identically on each selected site of three national highways. On selected sites of Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways, pedestrian collision accident is 33%, 60%, 27% and head collision accident is 11%, 22%, 55% respectively of total accidents. Rear end collisions are observed significantly 34% and 9% on selected site of Dhaka-Chittagong and Dhaka-Aricha national highways.

Overturn accidents on selected site of Dhaka-Sylhet and Dhaka-Chittagong national highways are 20% and 11% of total accidents respectively.

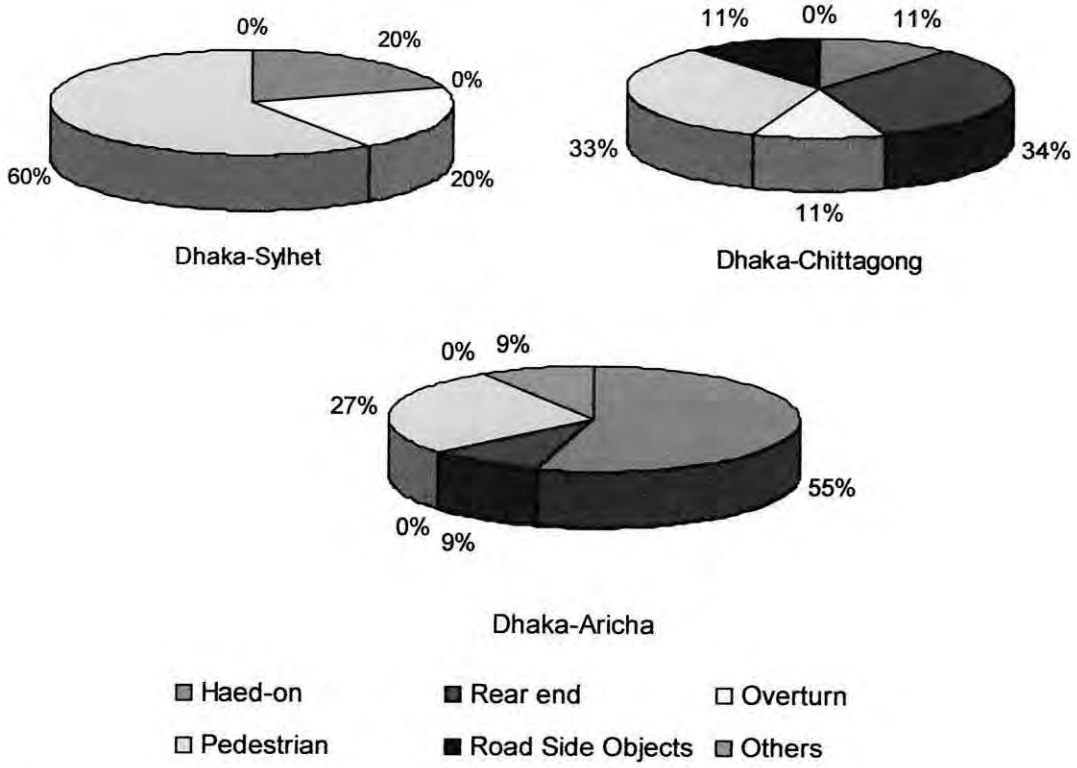


Figure 6.26: Comparative Accident Collision Types on First Selected Site

Table 6.22: Comparative Accident Casualty on First Selected Site

National Highway	Dhaka-Chittagong				Dhaka-Sylhet			Dhaka-Aricha			
	Km. Post-29.6				Km. Post-57			Km. Post-25.6			
	2001 to 2003				2004 to 2006			2001 to 2003			
Collision Types	Fatal	Grievous	Simple	Total	Fatal	Grievous	Total	Fatal	Grievous	Simple	Total
Head-on	-	4	2	6	1	6	7	-	-	-	-
Rear end	1	-	3	4	-	-	-	-	1	-	1
Overturn	1	-	-	1	1	-	1	-	-	-	-
Pedestrian	2	1	-	3	3	-	3	3	-	1	4
Road Side Object	-	-	1	1	-	-	-	-	-	-	-
Others	-	-	-	-	-	-	-	-	1	-	1
Total	4	5	6	15	5	6	11	3	2	1	6

Source: Accident Research Institute (ARI), 2008, BUET, Dhaka-1000

Table 6.22 reveals that casualty on selected site of Dhaka-Chittagong national highway is relatively more than other selected sites of Dhaka-Sylhet and Dhaka-Aricha national highway. On the other hand person died for accident is relatively more on the site of Dhaka-Sylhet national highway than selected site of other two national highways. Maximum casualty is observed for head-on collision on selected site of Dhaka-Chittagong and Dhaka-Sylhet highways. Casualty due to pedestrian collisions is identical on selected site of Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways.

Table 6.23: Comparative Accident Distribution on Second Selected Site

National Highway	Dhaka-Chittagong				Dhaka-Sylhet			Dhaka-Aricha			
	Km. Post-36.3				Km. Post-60			Km. Post-73.5			
	2001 to 2003				2004 to 2006			2001 to 2003			
Collision Types	Fatal	Grievous	Simple	Total	Fatal	Grievous	Total	Fatal	Grievous	Simple	Total
Head-on	2	1	1	4	-	-	-	2	4	-	6
Rear end	1	-	-	1	-	-	-	-	-	-	-
Overturn	1	-	1	2	-	-	-	1	1	1	3
Pedestrian	5	1	-	6	4	1	5	4	1	-	5
Road Side Object	-	-	2	2	-	-	-	-	-	-	-
Others	-	1	-	1	-	-	-	-	-	-	-
Total	9	3	4	16	4	1	5	7	6	1	14

Source: Accident Research Institute (ARI), 2008, BUET, Dhaka-1000

Another comparative study is done among selected sites on three national highways. The selected site of km. post 36.3 is located on Moddho Baushia area on Dhaka-Chittagong national highway. A bus stand is observed on this site. Second selected site on Dhaka-Sylhet national highway is located at km. post 60. This site is placed at Kundarpara bus stand. This is a market area where two side roads meet the main highway. On the other hand, selected km. post 73.5 is located on Pokuria bazaar on Dhaka-Aricha national highway.

From the analysis of table 6.23, it is clearly observed that total accident on the site of Dhaka-Chittagong national is more than other two selected sites of Dhaka-Sylhet and

Dhaka-Aricha national highways. Fatal accident is comparatively more at selected second site on Dhaka-Chittagong national highway than selected site of other two national highways. Accident severities as well as fatalities are than flowed by the site of Dhaka-Aricha national highway.

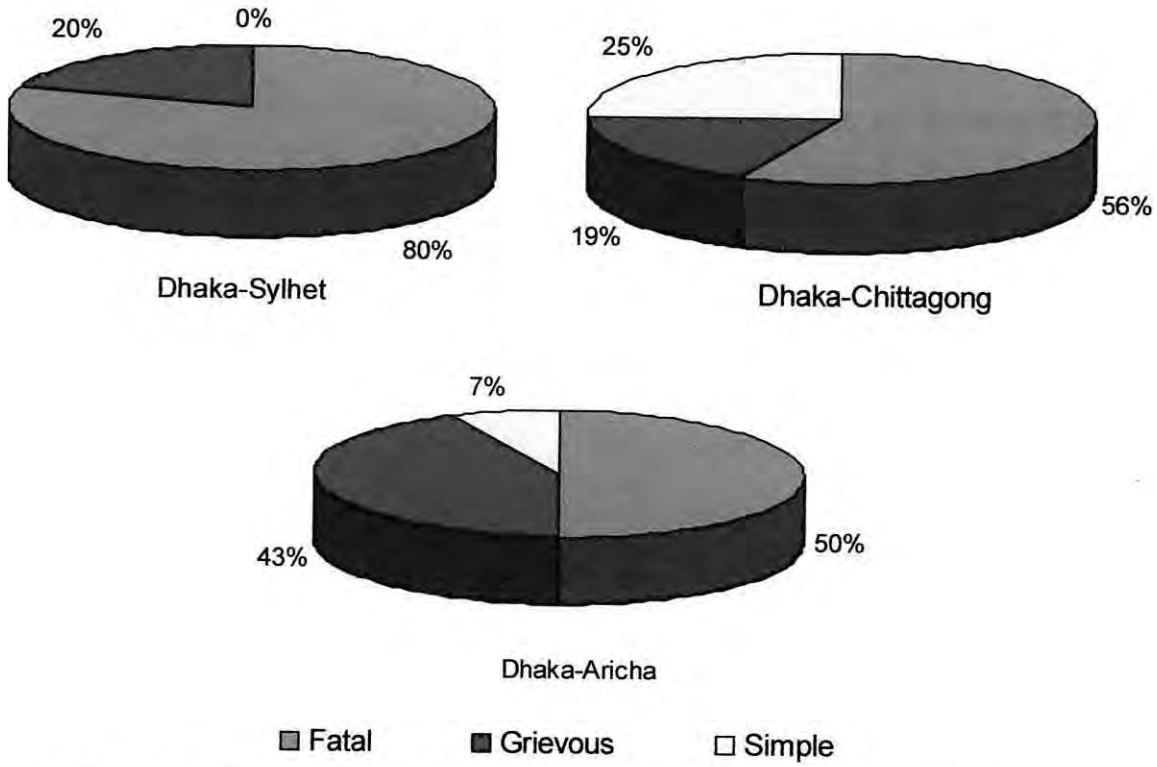


Figure 6.27: Comparative Accident Severity on Second Selected Site

From figure 6.27 it is clearly observed that the fatal accidents are dominating significantly more at selected site on Dhaka-Sylhet national highway than selected sites on Dhaka-Chittagong and Dhaka-Aricha national highways. Accident fatalities on selected sites of Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways are 56%, 80%, 50% respectively.

In figure 6.28, it is clearly observed that pedestrian collision type accidents are comparatively more than other collision types of accidents among selected sites of three national highways. At selected site on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha highways is observed 37%, 100% and 36% respectively. Overturn and head-on collision types of accidents are also observed considerable more on the selected site of Dhaka-Chittagong and Dhaka-Aricha national highways.

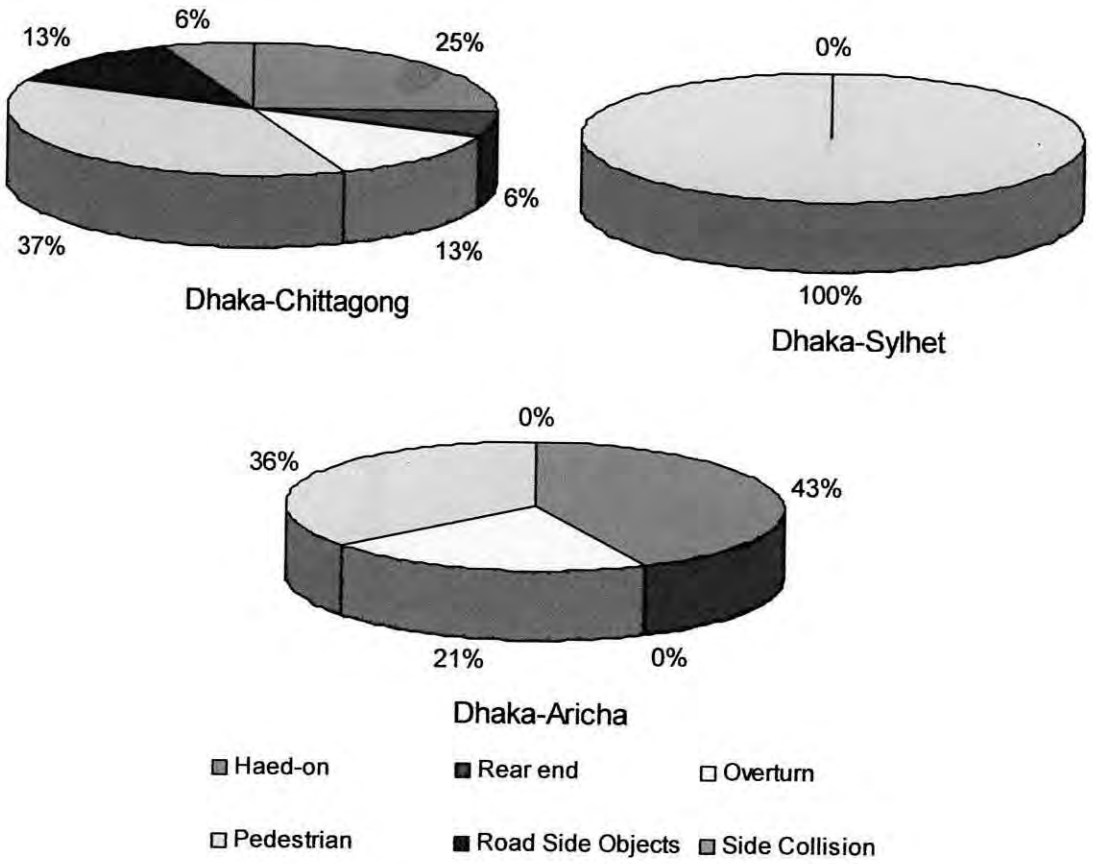


Figure 6.28: Comparative Accident Severities on Second Selected Site

Table 6.24: Comparative Accident Casualty on Second Selected Site

National Highway	Dhaka-Chittagong				Dhaka-Sylhet			Dhaka-Aricha			
	Km. Post-36.3				Km. Post-60			Km. Post-73.5			
	2001 to 2003				2004 to 2006			2001 to 2003			
Collision Types	Fatal	Grievous	Simple	Total	Fatal	Grievous	Total	Fatal	Grievous	Simple	Total
Head-on	13	5	3	21	-	-	-	8	13	8	29
Rear end	1	1	-	2	-	-	-	-	-	-	-
Overturn	1	1	3	5	-	-	-	1	2	3	6
Pedestrian	5	2	-	7	4	1	5	4	1	-	5
Road Side Object	-	2	3	5	-	-	-	-	-	-	-
Total	20	11	9	40	4	1	5	13	16	11	40

Source: Accident Research Institute (ARI), 2008, BUET, Dhaka-1000

From table 6.24, it is observed clearly that casualty at selected site on Dhaka-Chittagong and Dhaka-Aricha national highway is identical which is observed 8 times more than selected site on Dhaka-Sylhet national highway. Accident fatalities at selected site on Dhaka-Chittagong national highway are observed comparatively more the selected site on Dhaka-Aricha national highway. Fatality as well as casualty due to accident is occurred significantly more by head-on collision type's accident on Dhaka-Chittagong and Dhaka-Aricha national highways.

6.5.2 Comparative Study among Selected Nodes on Three National Highways

The selected node is located at km. post 27.4 ahead of Meghna Bridge on Dhaka-Chittagong national highway. This selected node is a T-junction which connects Meghna ghat with this national highway. Selected another km. post 50 is located at Shaheprotab on Dhaka-Sylhet national highway. This node contains a round about and connects Narshindhi district. On the other hand selected km. post 29.6 is located near National Smrity Shoudhu on Dhaka-Aricha national highway which is a T-junction. This node connects North Bengal corridor with Dhaka-Aricha national highway.

Table 6.25: Comparative Accident Distribution on First Selected Node

National Highway	Dhaka-Chittagong			Dhaka-Sylhet		Dhaka-Aricha	
	Km. Post- 27.4			Km. Post-50		Km. Post-29.6	
	2001 to 2003			2001 to 2003		2001 to 2003	
Collision Types	Fatal	Grievous	Total	Fatal	Total	Fatal	Total
Head-on	-	-	-	-	-	1	1
Rear end	2	1	3	1	1	-	-
Overturn	1	-	1	-	-	-	-
Pedestrian	1	-	1	4	4	3	3
Total	4	1	5	5	5	4	4

Source: Accident Research Institute (ARI), 2008, BUET, Dhaka-1000

From table 6.25, it is observed clearly that accident on selected nodes is identical on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways. All accidents at selected node on Dhaka-Sylhet and Dhaka-Aricha national highways are fatal types.

Rear end collision type accident is observed more at this selected site on Dhaka-Chittagong national highway. On the other hand pedestrian collision type accidents are

observed significantly more at selected nodes on Dhaka-Sylhet and Dhaka-Aricha national highway.

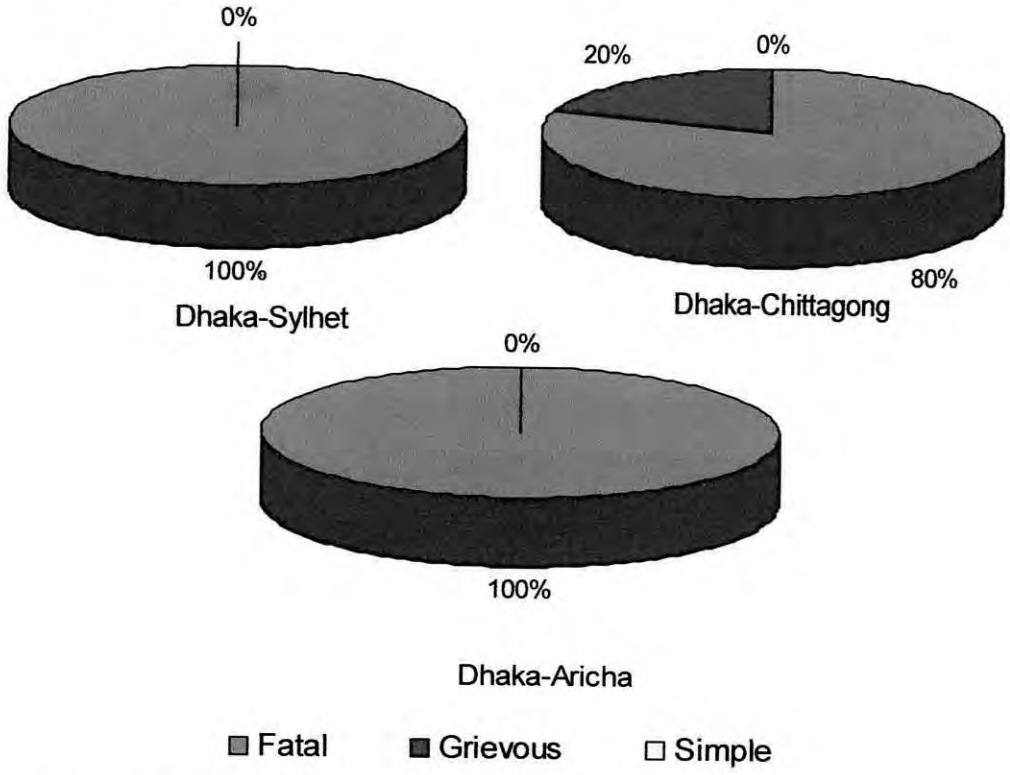


Figure 6.29: Comparative Accident Severities on First Selected Node

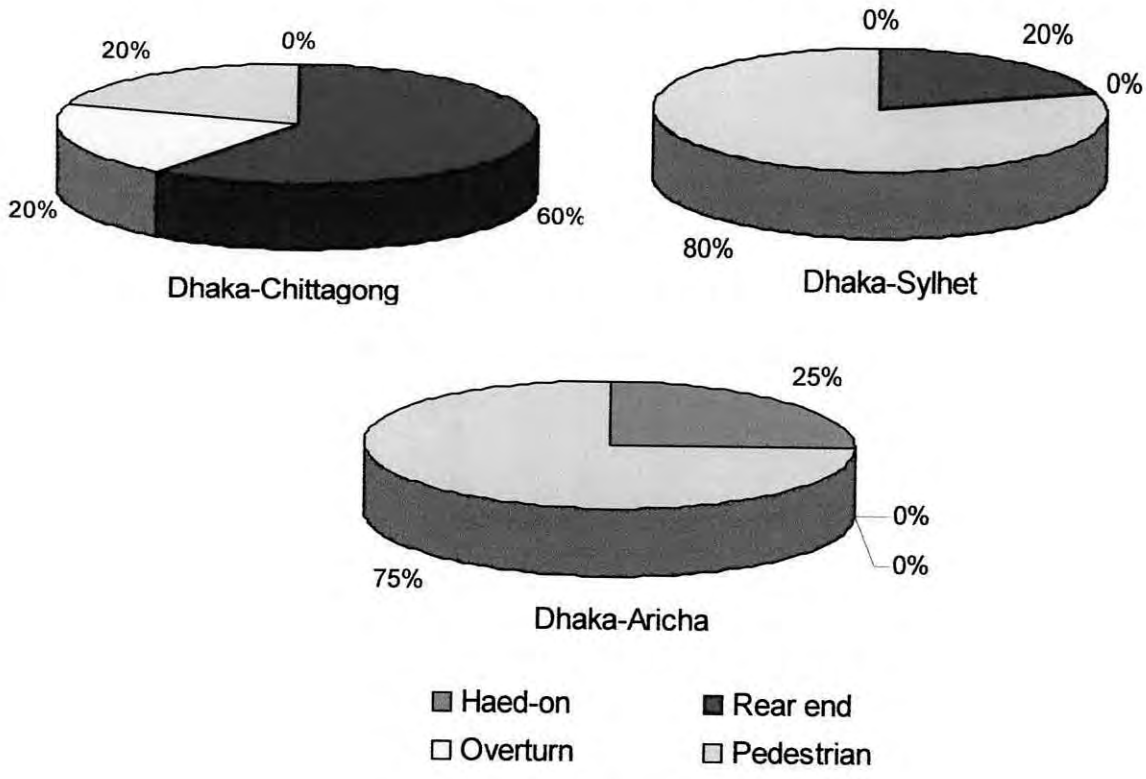


Figure 6.30: Comparative Accident Collision Types on First Selected Node

Pedestrian collision type accident is observed 75% and 80% of total accidents at the selected node on Dhaka-Sylhet and Dhaka-Aricha national highway respectively. Rear end collision type accident is also observed significantly 60% and 20% of total accident at selected node on Dhaka-Chittagong and Dhaka-Sylhet national highways respectively.

Table 6.26: Comparative Accident Casualty on First Selected Node

National Highway	Dhaka-Chittagong				Dhaka-Sylhet			Dhaka-Aricha		
	Km. Post- 27.4				Km. Post-50			Km. Post-29.6		
	2001 to 2003				2001 to 2003			2001 to 2003		
Collision Types	Fatal	Grievous	Simple	Total	Fatal	Grievous	Total	Fatal	Grievous	Total
Head-on	-	-	-	-	-	-	-	2	1	3
Rear end	3	1	-	4	1	1	2	-	-	-
Overturn	2	2	1	5	-	-	-	-	-	-
Pedestrian	1	-	-	1	4	-	4	3	-	3
Total	6	3	1	10	5	1	6	5	1	6

Source: Accident Research Institute (ARI), 2008, BUET, Dhaka-1000

From analysis of casualty table 6.26, it is observed that casualty at selected node on Dhaka-Chittagong national highway is comparatively more than selected site on Dhaka-Sylhet and Dhaka-Aricha national highways. Casualty due to accident on Dhaka-Sylhet and Dhaka-Aricha national highway is identical. Casualty due to overturn and rear end collision type's accidents are occurred more at selected node on Dhaka-Chittagong national highway. On the other hand casualty due to pedestrian collision type accident is observed significantly more at selected node on Dhaka-Sylhet and Dhaka-Aricha national highways.

In this section, another comparative study is done at second selected node on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways. The name of selected node at km. post 157.5 on Dhaka-Chittagong national highway is Mohipal. This node is a T-junctions. The name of second selected node on Dhaka-Aricha national highway at km. post 59 is Itakhola. On this node, a road connects Shippur thana with Dhaka-Sylhet national highway. A round about is observed at this selected node. On the other hand, second selected node is located at km. post 57.6 on Dhaka-Aricha national

highway. This node is a T-junction and called Saturia intersection. This node is also Glora-Kamta bus stand.

Table 6.27: Comparative Accident Distribution on Second Selected Node

National Highway	Dhaka-Chittagong				Dhaka-Sylhet			Dhaka-Aricha		
	Km. Post- 157.5				Km. Post-59			Km. Post-57.6		
	2001 to 2003				2004 to 2006			2001 to 2003		
Collision Types	Fatal	Grievous	Simple	Total	Fatal	Grievous	Total	Fatal	Grievous	Total
Head-on	1	-	-	1	-	-	-	-	1	1
Rear end	-	1	-	1	-	-	-	-	1	1
Overturn	-	1	-	1	-	-	-	-	1	1
Pedestrian	2	1	-	3	4	1	5	1	1	2
Road Side Object	-	1	1	2	-	-	-	-	-	-
Parked Vehicles	-	1	-	1	-	-	-	-	-	-
Others	-	-	-	-	-	-	-	1	-	1
Total	3	5	1	9	4	1	5	2	4	6

Source: Accident Research Institute (ARI), 2008, BUET, Dhaka-1000

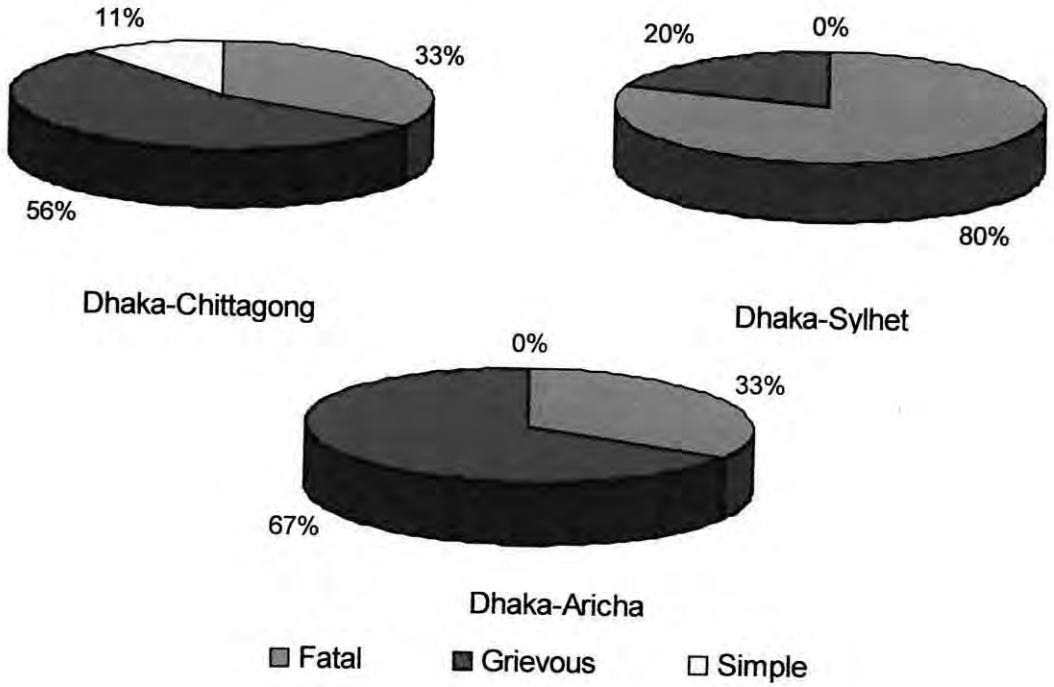


Figure 6.31: Comparative Accident Severities of Second Selected Node

From table 6.27, it is observed clearly that accident at selected second node on Dhaka-Chittagong national highway is comparatively more than selected site on Dhaka-Sylhet and Dhaka-Aricha national highways. Fatal accident at this selected node on Dhaka-Sylhet national highway is comparatively more than selected node of other two highways. Pedestrian collision type accident is observed more than other accident collision types among these selected nodes on three national highways.

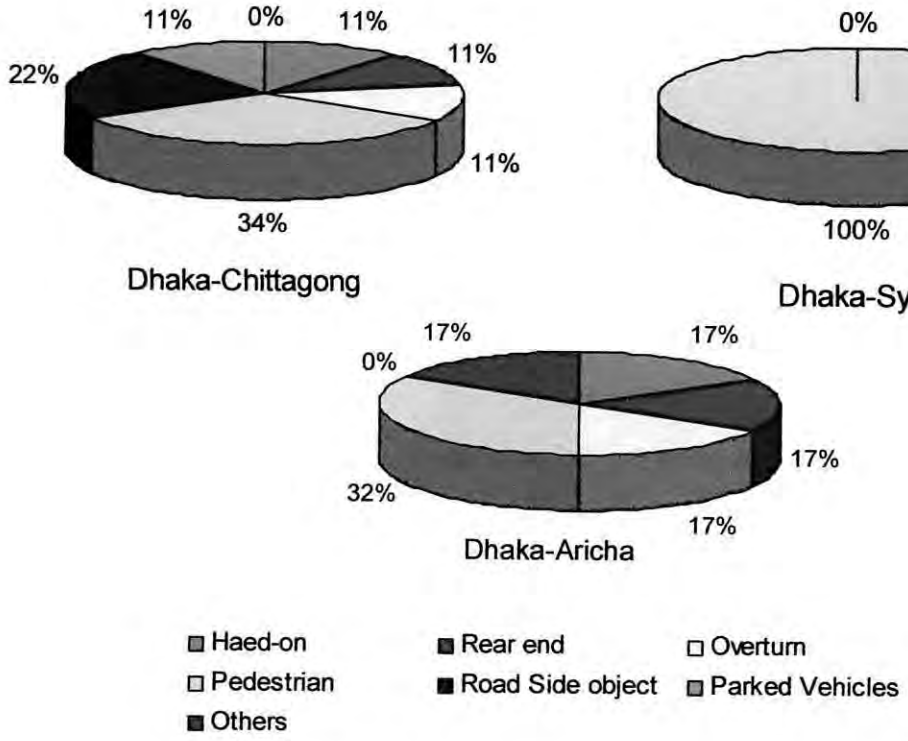


Figure 6.32: Comparative Accident Collision Types on Second Selected Node.

From the analysis of figure 6.32, it is clearly observed that pedestrian collision type accidents are 34%, 100% and 32% of total accidents at each selected node on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways. Head-on, rear end and overturn collision types accident are observed significantly more at second selected node on Dhaka-Chittagong and Dhaka-Aricha national highways.

Table 6.28: Comparative Accident Casualty on Second Selected Node

National Highway	Dhaka-Chittagong Km. Post- 157.5 2001 to 2003				Dhaka-Sylhet Km. Post-59 2004 to 2006			Dhaka-Aricha Km. Post-57.6 2001 to 2003			
Collision Types	Fatal	Grievous	Simple	Total	Fatal	Grievous	Total	Fatal	Grievous	Simple	Total
Head-on	-	-	-	-	-	-	-	-	3	2	5
Rear end	3	1	-	4	-	-	-	-	2	3	5
Overturn	2	2	1	5	-	-	-	-	1	4	5
Pedestrian	1	-	-	1	4	1	5	1	1	-	2
Others	1	-	-	1	-	-	-	1	-	-	1
Total	7	3	1	11	4	1	5	2	7	9	18

Source: Accident Research Institute (ARI), 2008, BUET, Dhaka-1000

From analysis of accident casualty table 6.28, it is observed that casualty at selected node on Dhaka-Aricha national highway is comparatively more than selected node on Dhaka-Chittagong and Dhaka-Sylhet national highways. Casualty at selected node on Dhaka-Chittagong national highway is more than selected node on Dhaka-Sylhet national highway. Casualty due to overturn and rear end collision is observed more at selected node on Dhaka-Chittagong highway. Casualty due to pedestrian collision is observed only at selected node on Dhaka-Sylhet national highway. On the other hand casualty due head-on, rear end and overturn collision is observed significantly more at selected node on Dhaka-Sylhet national highway.

6.6 Overview

In this chapter a comparative analysis are done at selected site and node on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways. This chapter views that accident on selected site and node on Dhaka-Chittagong national highway is comparative more than Dhaka-Sylhet and Dhaka-Aricha national highway. Fatal accident is comparatively more than other severity of accident. This chapter also lays emphasis at some black spots on Dhaka-Sylhet national highway.

The next chapter is the conclusion of this study with general findings and recommendation for further study.

CHAPTER – 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction:

In this study several attempt has been made to see in depth into the comparison of accident patterns on three selected national highways in Bangladesh. The next attempt in this study is to find out comparative study of average daily traffic and accidents on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways. Another attempt in this study is also to find out high accident frequency location with available accident data and identification of probable causes of accidents with remedial improvements for several spots on Dhaka-Sylhet national highway. Last attempt is to make a comparison among selected site and node on these national highways.

In view of this research project investigation on comparative accidents characteristics analysis, comparative average daily traffic and accident analysis and comparison among selected site and node on three national highways several findings and recommendations are made. This chapter briefly presents findings of this study with some recommendations on these three national highways. This chapter is also recommended further several comparative studies on these national highways.

7.2 Summary of Findings

During this study, some important observations have been made related to accident data collection, average daily traffic data collection, preservation system of observed data, selection system of black spot, investigation of some black spots, vehicle classification system at toll plaza, speed observations etc. This section briefly discusses the important findings from this comparative accident study.

7.2.1 Study Findings

The following findings are summarized by the study of comparative accidental data:

- Accident per kilometer on Dhaka-Aricha national highway is 5.3, which is 1.84 times more than Dhaka-Chittagong highway and 3.4 times more than Dhaka-Sylhet highway.
- Fatal accident is comparatively more than other severity of accidents on Dhaka-Sylhet national highway. Accident fatality on Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways is observed 69%, 74% and 64% respectively.
- On Dhaka-Chittagong, Dhaka-Sylhet and Dhaka-Aricha national highways accident involved due to large bus is 29%, 32% and 38% respectively and truck is 40%, 28% and 30% respectively.
- During 10.00 A.M to 12.00 P.M., 12% and 19% of accident are observed on Dhaka-Chittagong and Dhaka-Aricha national highways. On Dhaka-Sylhet national highway between 16.00 P.M to 18.00 P.M, 16% of total accidents are observed.
- More than 70% accidents are observed during day and around 30% accidents are observed after sun set for Dhaka-Sylhet and Dhaka-Aricha national highway. On the other hand 61% accidents are observed during day and rest 39% accidents are observed during night on Dhaka-Chittagong national highway.
- Around 90% accidents are occurred in rural areas on three study national highways where vehicle speed is too much high and around 10% accidents are occurred on urban area.
- Average daily traffic of Dhaka-Chittagong national highway is around 2.3 times more than Dhaka-Sylhet and 1.7 times more than Dhaka-Aricha national highway.
- Maximum vehicle class is small buses and trucks which are about 38% for Dhaka-Chittagong and Dhaka-Aricha national highway and 49% for Dhaka-Sylhet national highway.

- Truck involved in accident are comparatively more over other vehicles on three national highways which are around 29%.
- Accident occurs significantly more at selected site on Dhaka-Chittagong national highway and than flowed by the site of Dhaka-Aricha national highway. Accident frequency at selected site on Dhaka-Sylhet national highway is comparatively minimum.
- Accident casualties are also observed comparatively more at selected site on Dhaka-Chittagong national highway than other selected site of Dhaka-Sylhet and Dhaka-Aricha national highway.
- At node on Dhaka-Chittagong national highway accident frequency is also more over other selected node of Dhaka-Sylhet and Dhaka-Aricha national highways.

7.2.2 Field Observations

General findings of this analysis of data which are directly collected from the field survey described bellow.

- Random pedestrian crossing which makes surprise situation for the drivers and in consequence many serious accidents is occurring.
- At different locations, presences of road side hat-bazaar are causing lot of accident on the national highways in rural areas.
- It is found that road condition particularly pavement surface is observed very good and offering very smooth riding quality in many places.
- Almost in every bridge and culvert there is an offset between road top and deck slab which is very dangerous particularly for overloaded heavy vehicles.
- Speed study conducted at selected locations reveals that most of the vehicles particularly large busses, private car and micro etc run exceeding speed limit.
- Physical measures including additional road sign, road marking, foot-path and segregation railing for pedestrian, bus lay-bays, separate non motorized lane, Krebs, Island are not available for many places.
- Hawkers on foot path makes sometimes unwilling to use pedestrians for safety measures.

- Drying of agricultural products near the highway is a significant scenario which also breaks concentration of drivers.
  - Keeping domestic animals near the highway for grazing are sometimes come on main approach road results accidents.
  - Shoulders are not continued across the structure. For this non motorized vehicles are moved out into the carriageway in front of fast moving vehicles and there may be accidents.

7.3 Recommendations

- Self enforcing speed calming device can be installed in case of complicate in widening of the structures commensuration with the pavement width.
- Curves and Junctions are the most risky black spot on the national highway. Following measures should be considered for these black spots:
  - Self enforcing speed calming device such as rumble strips, jiggle bars etc. can be installed to force driver to reduce his approaching vehicle speed as well as draw his attention.
  - There is a need to replace existing rigid type guard post by w-beam or flexible cable type safety barrier in order to reduce severity of accident.
- Guard post with chevron should be considered at curve area on national highway.
- Elevated footpath with safety barrier should be considered at traffic congestion area on national highway.

7.4 Recommendation for Further Study

- Comparative accident severity index and collision types study on these national highways should be done.
- Comparative directional distribution of accident should be conducted on these national highways.
- Comparative traffic and accident change analysis on these national highways.
- Comparative accident patterns on black spots among these national highways.
- Comparative economic analysis for accident on these national highways.

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