

REPORT ON
DETAILED
ROAD SAFETY AUDIT
OF FIVE ROAD SECTIONS
(500 KM)



ROAD SAFETY AUDIT REPORT FY 2017-2018

Road Design & Safety Circle
Roads & Highways Department
Government of the People's Republic of Bangladesh
SARM Associates and HeptaTech Limited JV



REPORT

On

Detailed Road Safety Audit of Road Sections of Joydebpur – Mymensingh (N3), Kanchpur- Daudkandi (N1) and Chattogram – Cox's Bazar (N1), Kashinathpur – Rajshahi (N6) and Dhaka – Aricha (N5) (Total 500 km) National Highway During FY 2017 -2018

CLIENT

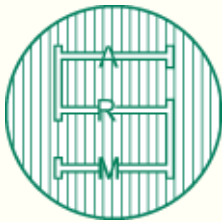
Road Design and Safety Circle
Elenbari, Tejgaon, Dhaka
Roads and Highways Department



CONSULTANT

SARM Associates and HeptaTech Limited JV

JULY 2018



REPORT ON

Detailed Road Safety Audit of Road Sections of Joydebpur-Mymensingh (N3), Kanchpur-Daudkandi (N1) and Chattogram-Cox's Bazar (N1), Kashinathpur-Rajshahi (N6) and Dhaka-Aricha (N5) (Total 500 km) National Highway during FY 2017-2018.

EDITORIAL BOARD

Engr. Mohi Uz Zaman Quazi
Engr. Arif Uddin
Engr. Shahriar Sarkar
Engr. Kazi Hosne R Rafy
Engr. Mushab Bin Khondokar
Engr. Probir Gopal Roy

ADVISORY BOARD

Prof. Dr. Md. Mazharul Hoque
Prof. Dr. AKM Fazlur Rahman
Dr. Md. Kamran Ul Baset

CLIENT

Government of the People's Republic of Bangladesh

IMPLEMENTER

SARM Associates and HeptaTech Limited JV

TOP SUPERVISION

Roads and Highways Department (RHD), Bangladesh

PUBLICATION YEAR

July 2018

CONTACT

HeptaTech Limited
Address: House#506/A, Road#35, New DOHS, Mohakhali
Dhaka – 1206, Bangladesh
Phone: +88 01742305257
Email: info@heptatechbd.com

FOREWORD

The audit team would like to appreciate the cooperation of 'The Road Design and Safety Circle' of Roads and Highways Department (RHD), Bangladesh during the working tenure for their valuable opinion and guidance on the audit checklist, inception report, interim report, and draft final report. The consultant team would also like to express its sincere gratitude to the advisor, Dr. Md. Mazharul Hoque, Professor, Department of Civil Engineering, University of Information Technology and Sciences for his continuous support throughout the project with immense patience, motivation, enthusiasm and vast knowledge. His continuous guidance helped the audit team during road audit and report preparation. The team would also like to thank Prof. Dr. AKM Fazlur Rahman, for his encouraging and insightful comments. The team wishes to express sincere thanks to Accident Research Institute (ARI), BUET for allowing to use crash data.

The overall contribution from the Centre for Injury Prevention and Research, Bangladesh (CIPRB) during whole project period is highly appreciated.

Special gratitude goes to all the senior officials of RHD in field level and Highway police officials of the audited road length for their valuable advices on existing hazards of the highway.

The consultant team is very much looking forward to work further with Bangladesh government on a roll out of this successful program to other high-risk corridors and highways within the road network in Bangladesh.

EXECUTIVE SUMMARY

The main objective of this project was to assess potential safety hazards on road sections of Joydebpur–Mymensingh (N3), Kanchpur-Daudkandi (N1) and Chattogram–Cox’s Bazar (N1), Kashinathpur–Rajshahi (N6) and Dhaka–Aricha (N5) (Total 500 km) National Highway using road safety auditing tools and to recommend possible options for remedial treatment. At first existing “Guidelines for Road Safety Audit, 2005” of Roads and Highways Department (RHD), Bangladesh was reviewed as well as guidelines of developed countries were analyzed to find out the improvement options of RHD guidelines. A detailed checklist was prepared addressing the RHD guidelines and other leading road agencies such as Austroads, Indian Road Congress. Crash data was collected to supplement audit findings. Considering the local traffic composition, some new indicators were addressed in audit checklist. Some of the striking issues are: scope of the highway, accessibility, night inspection, hazardous locations, side roads, speed breakers, road users’ behavior, enforcement, non-standard vehicles etc. Two team consisting of road safety auditors and social scientists conducted the field visits from May 10, 2018 to June 12, 2018 to identify possible hazards as listed in the checklist through conducting highway geometric study, site specific deficiencies of road elements, built-up area condition, school zone environment, vehicular and pedestrian composition and related safety issues. Local traffic conditions were critically observed during the whole study. Field observation reveals that along these corridors, drivers of heavy vehicles particularly of buses are always in fierce competition and also have the tendency of making risky overtaking maneuver which is often induced by presence of slow moving vehicles and unaware pedestrians resulting unsafe and hazardous traffic operating condition. Analyzed crash data of 5 years (2011-2015) also support this observation as predominance of pedestrian related crashes followed by head-on collision crashes, rear end collision crashes and other types of crashes causing 236 fatalities from 173 crashes reflecting the vulnerability of these highways. Furthermore, the audit has identified some potential risks that may induce severe road crash at any time. Major flaws addressed during the audit are: absence of access control measures, sharing same track by slow and non-motorized vehicle along with high speed vehicle, increased number of

hazardous locations, increased road side non-motor activities, untreated divider opening etc. For immediate result, the audit team suggested 362.9km shoulder treatment, 9111 additional road sign requirement, 241.7km road marking installation and adequate facility improvisation on 81.6km built-up areas of the surveyed 500km highways. In addition to the recommendations made in the audit report, the study also proposed few suggestions to mitigate probable safety hazards to be aroused due to expected rapid urbanization. Worth mentioning suggestions are: strict access control to national highway, development of highway-adjacent land using policy, building up of local road network, and upgrading at-grade junctions by constructing grade separated interchange facility etc.

TABLE OF CONTENTS

NAME	Page
Abbreviations	6
List of Figures.....	7
List of Tables.....	9
Chapter 1: Introduction.....	10
Chapter 2: Project Management.....	13
Chapter 3: General Observation During Audit	16
Chapter 4: Audit Process and Methodology	18
Chapter 5: Results.....	27
Chapter 6: Conclusions	138
Chapter 7: Photo Gallery	148
Chapter 8: References	153
ANNEXURE- A: Site Specific Intervention Locations	154
ANNEAXURE- B: Meeting Minutes of Commencement Meeting.....	184
ANNEAXURE- C: Filled Checklists of Audited Highways (Separate Book).....	187
ANNEAXURE- D: DVD of RAW Data & Site Pictures	188

ABBREVIATIONS

AADT-Annual Average Daily Traffic

ARI-Accident Research Institute

BRTA-Bangladesh Road Transport Authority

BUET-Bangladesh University of Engineering and Technology

CNG-Compressed Natural Gas

GDP- Gross Domestic Product

GDPPC- Gross Domestic Product Per Capita

GPS-Global Positioning System

HBB-Herringbone Bond

HRL-Hazardous Road Location

LGED-Local Government Engineering Department

LRP-Location Reference Point

MAAP-Microcomputer Accident Analysis Package

MV-Motorized Vehicle

NMT-Non Motorized Transport

NMV-Non Motorized Vehicle

RHD-Roads and Highways Department

RSA-Road Safety Audit

TOR-Term Of Reference

UN- UNITED NATION

LIST OF FIGURES

NAME		PAGE
Figure 2.1	Project Management of RSA (Services)	14
Figure 2.2	Road Safety Audit Project Time Schedule	15
Figure 4.1	Steps in Road Safety Audit Project	20
Figure 4.2	Checklist for Road Safety Audit	25
Figure 4.3	Checklist for Night Time Audit	26
Figure 5.1	Road Section of Chattogram-Cox'sBazar Highway (N1)	27
Figure 5.2	AADT Demand Situation on Chattogram-Cox'sBazar Highway (N1)	28
Figure 5.3	Hazards within 2m of Shoulder on Chattogram-Cox'sBazar Highway (N1) (Both Sides)	29
Figure 5.4	Earthen Shoulder Condition on Chattogram-Cox'sBazar Highway (N1) (Both Sides)	30
Figure 5.5	Pavement Condition on Chattogram-Cox'sBazar Highway (N1)	32
Figure 5.6a	Intersections, Built-up Areas and School Zones on Chattogram-Cox'sBazar Highway (N1)	37
Figure 5.6b	Intersections, Built-up Areas and School Zones on Chattogram-Cox'sBazar Highway (N1)	38
Figure 5.7	Road Section of Kashinathpur – Rajshahi Highway (N6)	47
Figure 5.8	AADT Demand Situation on Kashinathpur - Rajshahi Highway (N6)	48
Figure 5.9	Hazards within 2m of Kashinathpur - Rajshahi Highway (N6) (Both Sides)	49
Figure 5.10	Earthen Shoulder Condition on Kashinathpur - Rajshahi Highway (N6) (Both Sides)	50
Figure 5.11	Pavement Condition on Kashinathpur - Rajshahi Highway (N6)	52
Figure 5.12a	Intersections, Built-up Areas and School Zones on Kashinathpur - Rajshahi Highway	57
Figure 5.12b	Intersections, Built-up Areas and School Zones on	58

NAME		PAGE
	Kashinathpur - Rajshahi Highway	
Figure 5.13	Road Section of Gazipur - Mymensingh Highway (N3)	68
Figure 5.14	AADT Demand Situation on Gazipur-Mymensingh Highway (N3)	69
Figure 5.15	Hazards within 2m of Shoulder on Gazipur-Mymensingh Highway (N3) (Both Sides)	70
Figure 5.16	Earthen Shoulder Condition on Gazipur-Mymensingh Highway (N3) (Both Sides)	71
Figure 5.17	Pavement Condition on Gazipur-Mymensingh Highway (N3)	73
Figure 5.18	Intersections, Built-up Areas and School Zones on Gazipur-Mymensingh Highway (N3)	78
Figure 5.19	Road Section of Dhaka-Aricha Highway (N5)	98
Figure 5.20	AADT Demand Situation on Dhaka - Aricha Highway (N5)	99
Figure 5.21	Hazards within 2m of Shoulder on Dhaka-Aricha Highway (N5) (Both Sides)	100
Figure 5.22	Earthen Shoulder Condition on Dhaka-Aricha Highway (N5) (Both Sides)	101
Figure 5.23	Pavement Condition on Dhaka-Aricha Highway (N5)	103
Figure 5.24	Intersections, Built-up Areas and School Zones on Dhaka-Aricha Highway (N5)	108
Figure 5.25	Road Section of Kanchpur – Daudkandi Highway (N1)	118
Figure 5.26	AADT Demand Situation on Kanchpur-Daudkandi Highway (N1)	119
Figure 5.27	Hazards within 2m of Shoulder on Kanchpur-Daudkandi Highway (N1) (Both Sides)	120
Figure 5.28	Earthen Shoulder Condition on Kanchpur-Daudkandi Highway (N1) (Both Sides)	121
Figure 5.29	Pavement Condition on Kanchpur-Daudkandi Highway (N1)	123
Figure 5.30	Intersections, Built-up Areas and School Zones on Kanchpur-Daudkandi Highway (N1)	128

LIST OF TABLES

NAME		PAGE
Table 2.1	Road Safety Audit Team	13
Table 6.1	Carriageway Wise Crash Type	138
Table 6.2	Preliminary Quantity for Immediate Measures	142

CHAPTER 1



INTRODUCTION

'The main objective of the study is to ascertain whether the safety needs of all road users have been accommodated in the road environment. Points to be emphasized are adequacy of roadway capacity, adequacy of street furniture (signs, pavement markings, guard rails), vulnerability due to road side obstructions (shops, markets), adequacy of sight distance, needs of vulnerable road users (pedestrians), access management, adequacy of speed control, and functioning of intersections...'

INTRODUCTION

Transport is a key component and a crucial contributor to the social and economic development of any society. Depending upon how it is measured, transportation is responsible between 10-15 percent of Bangladesh's gross domestic product (GDP) and is accounting for nearly 15 percent of occupational employment. About 25 percent of government annual capital expenditure for development is put to transport development works. Transportation is thus a substantial part of the national economy and an important determinant of our lifestyle. Road transport in the carriage of freight and passenger traffic is by far the major mode of transportation in Bangladesh, accounting for more than 80 percent in tonne-km and more than 88 percent in Passenger-km respectively. Clearly, road transport continues to deliver opportunities for increasing mobility and benefits to economic growth and the way we work and live. However, in recent years, the rapid urbanization process, high vehicular and population growth rates and that of increased levels of mobility, inadequate transportation facilities and policies, varied traffic mix with over concentration of non-motorized vehicles, absence of dependable public and mass transportation system and inadequate traffic management practices have resulted in substantial road crash problems.

In Bangladesh, recent nationwide survey on the cause and effect of injuries (Bangladesh Health & Injury Survey II) revealed that 23,166 people are being killed annually on roads with a rate of 14.4/100,000 fatal road traffic injury irrespective of age. The tragic, premature, costly loss of lives and permanent disabilities as a result of road traffic crashes are exacerbating poverty reduction efforts. Globally, Road traffic crash, one of the leading causes of death around the world, kills 1.2 million people every year and causes 3% GDP loss for the low -and middle-income countries. Hence, road safety is a huge concern for policy makers in last couple of years.

Roads and Highways Department (RHD) is the Apex road agency in Bangladesh. RHD owns total 21302.08 km of roads comprising of 3812.78 km of national highways, 4246.97 km of regional highways and 13242.33 km of District Highways. In road

network development, ensuring road safety is a major challenge to make reliable, safe and sustainable infrastructure. Road safety has been highlighted in 2 of the 17 Sustainable Development Goals (SDGs), among which, Goal 3 contains target 3.6- “By 2020, halve the number of global deaths and injuries from road traffic crashes” and Goal 11 contains target 11.2- ‘By 2030, provide access to safe, affordable and sustainable transport for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons.’”

The goal of UN Decade of Action for Road Safety 2011-2020 is to achieve 50 percent reduction in road traffic crash fatalities by 2020. Accordingly RHD has undertaken various initiatives as per national strategic action plan, where road safety audit is a vital part for identifying the problems and issues related to safety.

Though some road safety features are incorporated in the various completed projects, still there is not enough or appropriate signs, symbols or road markings on many highways. Moreover, some inappropriate road signs and markings are observed in the road network through field observations and visits.

Research shows that significant numbers of crashes are highly concentrated at few locations. Such locations with abnormally high concentration of road crashes are identified as ‘Hazardous Road Locations’ (HRL). In Bangladesh, about 43 percent of national highway crashes are concentrated on 5 percent of the total length, demonstrating that crashes are highly clustered at few sections and they are amenable to targeted and site specific treatments (Hoque, 2006). These hazardous locations could be at an intersection, mid-block section or a short section of the road with a proven history of high crash density.

RHD has initiated the safety audit of five National Highways (Dhaka-Aricha, Joydebpur-Mymensingh, Kashinathpur-Rajshahi, Kanchpur–Daudkandi and Chattogram-Cox’s Bazar) with a total length of about 500 km. The main objective of the study is to ascertain whether the safety needs of all road users have been accommodated in the road environment. Points to be emphasized are adequacy of roadway capacity, adequacy of street furniture (signs, pavement markings, guard rails), vulnerability due to road side obstructions (shops, markets), adequacy of sight

distance, needs of vulnerable road users (pedestrians), access management, adequacy of speed control, and functioning of intersections. The final outcome of the study is to deliver a road safety audit report summarizing the findings based on the analysis of the field survey data along with recommendation which RHD will adopt in mitigation of the safety hazard.

The consultancy contract was signed on April 18, 2018. The consultant mobilized the team immediately and started their work in their fully equipped office at Mohakhali. The consultant has mobilized two vehicles, and procured required number of GPS equipment for their field survey.

CHAPTER 2

PROJECT MANAGEMENT



'The project is a joint effort of HeptaTech and SARM with the continuous support from Technical Service Wing of Roads and Highways Department. Experts from HeptaTech played the key role with all sorts of technical expertise...'

PROJECT MANAGEMENT

The project is a joint effort of HeptaTech and SARM with the continuous support from Technical Service Wing of Roads and Highways Department. Experts from HeptaTech played the key role with all sorts of technical expertise. Project officials from different professional sectors were recruited prior to starting the activities. The project was initiated in field with initial field visit which resulted a detailed checklist and later on a detailed road safety audit. Following table & figure are illustrating the total project management in brief:

1.Road Safety Audit Team

The following Personnel were engaged for the project for whole project duration:

Table 2.1: Road Safety Audit Team

Name of personnel	Designation	Company Name
Engr. Mohi Uz Zaman Quazi	Team Leader	HeptaTech Limited
Engr. Mushab Bin Khondker	Project Coordinator	HeptaTech Limited
Engr. Probir Gopal Roy	Team Coordinator	HeptaTech Limited
Engr. Arif Uddin	Planning & Strategy Coordinator	Consultant
Engr. Shahriar Sarkar	Junior Road Safety Auditor & Data Analyst	HeptaTech Limited
Engr. Kuntal Biswas	Junior Road Safety Auditor	HeptaTech Limited
Engr. M. Hosne R Rafy	Junior Road Safety Auditor	HeptaTech Limited
Engr. Iftekhar Ahmed	Technical Director & Senior Road Safety Auditor	SARM Associates Limited
Engr. Pankaz Kumar Ray	Senior Road Safety Auditor	SARM Associates Limited
Kazi Burhan Uddin	Social Scientist	Centre for Injury Prevention and Research, Bangladesh
Md.Shohel Rana	Social Scientist	Centre for Injury Prevention and Research, Bangladesh

2.Services

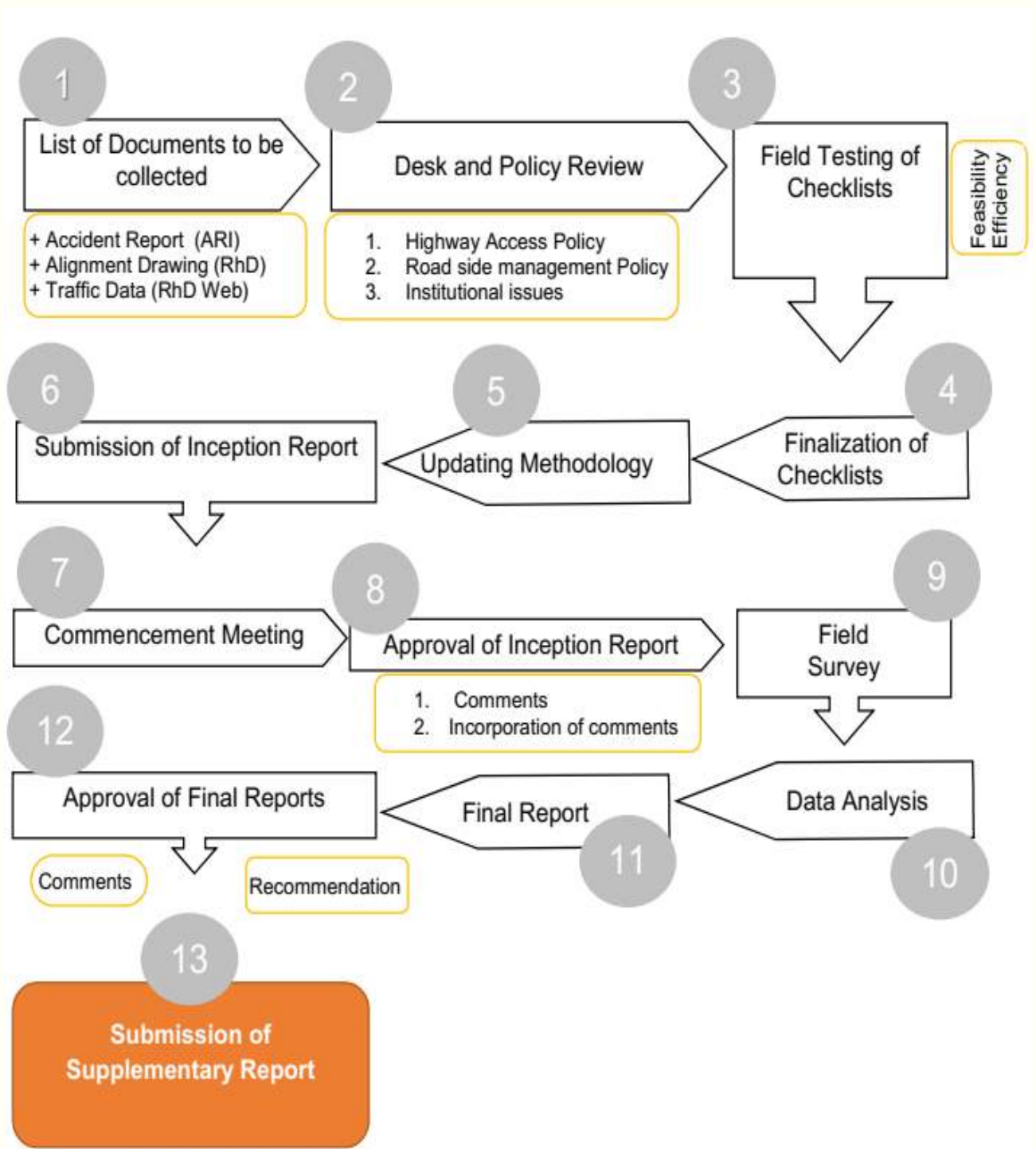


Figure 2.1: Project Management of RSA (Services)

3.Road Safety Audit Timeline: The road safety audit project schedule is illustrated in the figure as follows:

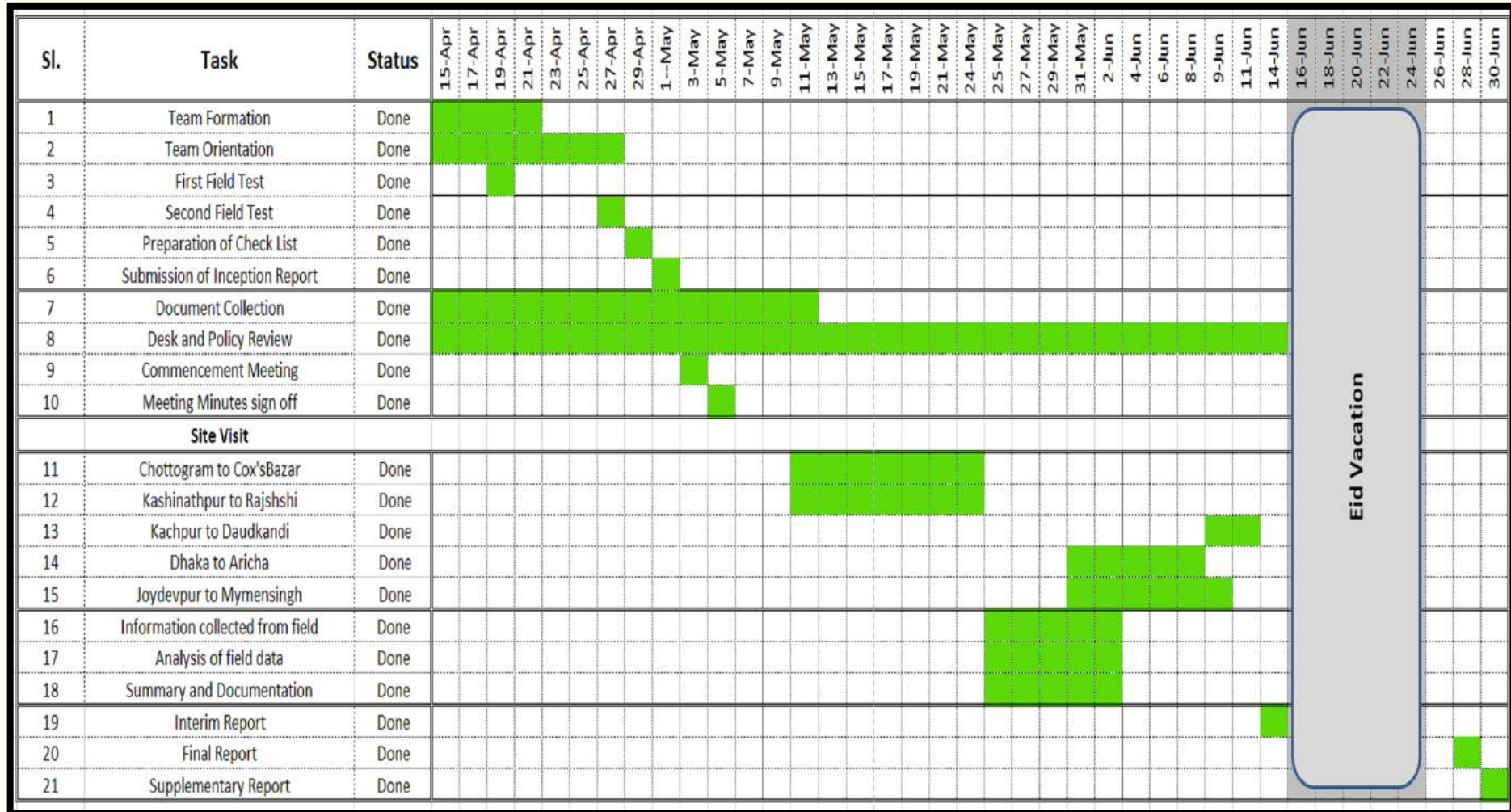


Figure 2.2: Road Safety Audit Project Time Schedule

CHAPTER 3

GENERAL OBSERVATION DURING AUDIT



'Heterogeneous vehicle composition was seen though heavy trucks and buses were dominating but low speed operated minibuses, tempos and other non-standard vehicles, particularly NMVs had regular access in the junctions from side roads...'

GENERAL OBSERVATION DURING AUDIT

Identified road users by survey team on the highway were:

- General public
- Commercial transport operators
- School vans
- Commercial bus operators
- Pedestrians
- Bicyclists
- Motorcyclists
- Agricultural machinery
- Tempo, Nosimon, Karimon

The survey section adjacent land of the highway was encompassed with

- Commercial shops and bazars
- Agricultural farms
- Petrol station
- Residential dwellings
- Rural residential development
- Schools
- Heavy vehicle operators and repair shops
- Roadside stalls
- Community recreation areas
- National park

Traffic and behavioral characteristics of the surveyed road length were:

- Heterogeneous vehicle composition was seen though heavy trucks and buses were dominating but low speed operated minibuses, tempos and other non-standard vehicles, particularly NMVs had regular access in the junctions from side roads.
- The heavy vehicles parked on either side of the road caused congestion.

- Frequent presence of roadside hazards like tree, pole or structures.
- Tendency of violation of traffics signs and markings like driving over speed limit, high speed intersection traffic, overtaking on curves etc.

Pedestrian activities and facilities of the surveyed road length were:

- There were no dedicated pedestrian sidewalk or crosswalk facilities and refuges on most length.
- No barriers or pedestrian guardrails had been provided to regulate their movements and for exposing them on significant danger.
- Unpredictable road crossing of pedestrian was seen as no zebra crossing was present.
- Unprotected school zones with lacking of pedestrian facilities for safe movement forcing to walk on highway road.
- Undetectable or faded zebra crossing marking and raised pedestrian facilities for drivers.

CHAPTER 4



AUDIT PROCESS

METHODOLOGY

'The project covered five major highway sections of the country which are in high demand due to heavy traffic. After completion of construction, the existing roads represent the present condition of the road as well as any hazardous conditions that may have been created during its lifetime...'

AUDIT PROCESS AND METHODOLOGY

The Road Safety Audit

The Austroads Guide to Road Safety Part 6: Road Safety Audit (2009) defines an RSA as: “a formal evaluation of an existing or future road or traffic project or an existing road, in which an independent, qualified team reports on the project’s crash potential and safety performance.”

An audit is not a check against standards. It’s a compliance with standards, which may represent the minimum requirements, does not guarantee safety.

The essential elements of this definition are that the audit is:

- A formal process and not an informal check
- An independent process
- Carried out by someone with appropriate experience and training
- Restricted to road safety issues.

The objectives of an RSA are:

- To identify potential safety problems for road users and others affected by a road project
- To ensure that the measures to eliminate or reduce the problems are considered in full.

The benefits of conducting RSAs include:

- The likelihood of crashes on the road network can be reduced
- The severity of crashes can be reduced.

The aim of an RSA is:

“To identify any existing safety deficiencies of design, layout and road furniture, which are not consistent with the road’s function and use. There should be such consistency among the standards that the road user’s perception of local conditions assists safe behavior.”

Stages of Road Safety Audit

Audit may be carried out for all or any number of the following stages of road planning, design, construction and maintenance:

1. Feasibility study
2. Preliminary design
3. Detailed design
4. Road under construction
5. Pre-opening stage of completed construction
6. Existing road
7. Traffic management scheme during road construction

As per TOR, the audit of existing road has been conducted in this project.

Methodology of Safety Audit on Existing Road

Safety audit methodology is successful on existing roads. The project covered five major highway sections of the country which are in high demand due to heavy traffic. After completion of construction, the existing roads represent the present condition of the road as well as any hazardous conditions that may have been created during its lifetime such as encroachments, ribbon development or deterioration of road conditions as well as traffic conditions etc.

To conduct successful audit on existing roads, an audit team should check planning, cross-sections, alignment, roadside furniture and facilities available, junctions, facilities for road users, signs, markings and lighting and roadside hazard.

Steps involved in road safety audit process are:

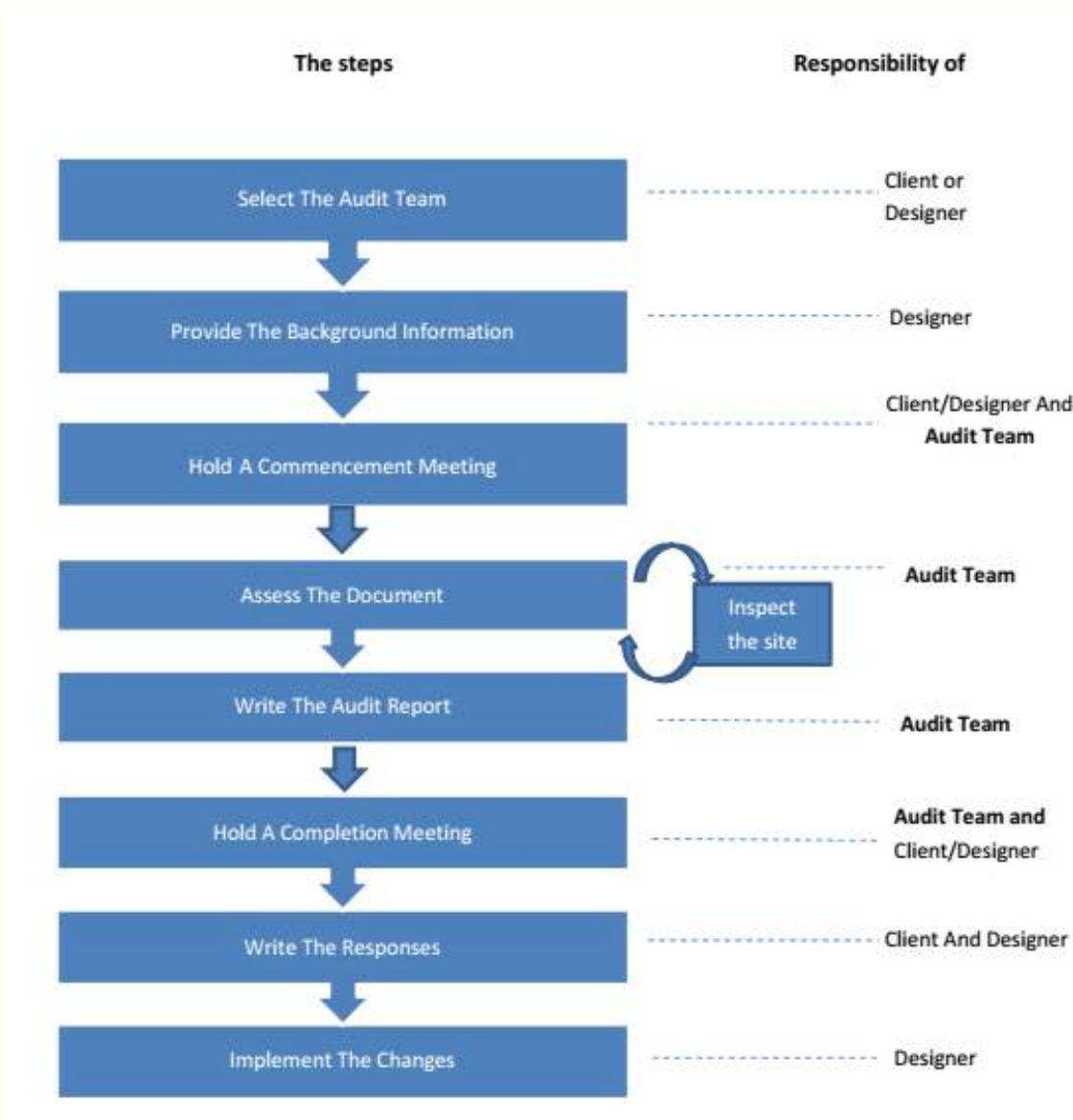


Figure 4.1: Steps in Road Safety Audit Project [Source: Austroads]

The steps in brief are:

1. Selecting Road Safety Audit Team

Each audit team consisting of road safety auditors and social scientists is comprised of three members, as the proposed project is vital and large. One of the team members will be nominated as road safety audit team leader. If required, retired police personnel would have been diploid for a limited time to provide advice on the relevant issues.

2. Providing the Background Information

The client arranges providing all the necessary information and documents in a usable form for the audit team. Information includes project reports, design details, data, drawings, etc. It is necessary to collect additional information, such as traffic volumes,

vehicular speed, etc. This is considered early enough to avoid delays to the road safety audit process. As a minimum, the audit team is provided with the following documents

- Statement of the expected outcome
- Project intent
- Site data
- Plans and drawings

3. Commencement Meeting

After the consultant auditors visiting to the stretch and getting acquainted themselves with the existing site conditions, a commencement meeting with the participation of auditors, client and design team of client, is organized to understand the context of road safety audit on selected stretch to share the perceptives of auditors, client and design team if any, as per guidelines. Minutes of the meeting drawn by Audit team brought out salient issues discussed in the meeting. The audit team's task is to identify and to make the road safety concern and recommendations documented.

4. Assessing the Documents

This phase takes place at the same time of the site inspection, the documents are viewed both before and after the site visit. Before inspecting the site, initially the documents are studied to record the first impressions, such as; list possible issues to be checked on site, plans and drawings, traffic and crash data and other information are assessed.

5. Inspecting the Site

This phase gives the audit team the opportunity to see how the project interacts with the surroundings and to visualize the potential obstacles and conflicts, which are likely to be encountered by the road users.

Prior to the site inspection the team prepares separate checklist for day time and night time audit. The inspection is carried out from the point of view of all road user groups and not just motorists.

6. Review of Existing Road

Road safety audit of assigned stretch is carried out with due diligence km by km through repeated visits to selected stretches, observations of the traffic conditions in different times during day/night, local enquiries, collection of crash data from police authorities and studying maps and other details. Safety concerns in each km is identified and feasible redress options are to be brought out keeping the context of selected stretch in view.

For conducting safety audit on existing roadway sections field studies like road inventory, classified volume counts, speed survey and study of first information reports from police records are essential. Following completion of road construction, safety audit report for an existing road, the highway authority will need to make an assessment on the cost effectiveness of the recommended solutions.

7. Road Inventory

Highway features determine road traffic safety, besides road capacity and economic traffic operations. Highway features are visible elements of highway and consist of various components. So, the safe and efficient operation of highway is governed by road geometric parameters, traffic control devices, lighting system of the stretch, composition of traffic, drainage condition, junction layout, parking facilities, cross drainage structures and the adjoining land use of the stretch.

Road geometry comprises parameters like road width, shoulder width, footpath, height of embankment, sight distance, horizontal curvature, vertical curvature, etc. The traffic control devices comprise signs, markings, delineators, crash barriers, guard rails etc.

8. Preparation of Safety Audit Report

The report contains the features of the project, deficiencies which involve hazards and make recommendations on corrective actions. The recommendations will reflect sound judgement of the audit team and should be backed with convincing reasons for appreciation by the decision makers. Further, these recommendations will indicate the directions rather than details of the solutions to improve safety. The responsibility for acceptance of the directions will rest with the client. On acceptance, the responsibility for detailing the solutions will rest with the designer.

The report should be a concise, brief document setting out a summary of the measures to be taken, the reasoning behind recommendation on such measures and the items identified that remedial measures/ treatment from the safety point of view are required. The recommendations should be numbered or identified in a way, which make them easy to refer to the follow-up reports.

Major parts of the reports are:

- a. Project information
- b. Background information
- c. Findings and recommendations
- d. Formal statement

9. Responding to the Audit Report

When audit report is received, it has to be acted upon so that safety is enhanced. The objective is to deal with audit recommendations in an effective and objective manner; to decide whether and how the recommendations on the road safety audit should be implemented and, where it is decided otherwise, to record the reasons in writing for such a decision; to put agreed audit recommendations into effect.

Client will furnish the auditors with their observations/views on audit recommendations within 15 days of submission of audit report. The auditors shall furnish to the client within 15 days of furnishing the observations/views of client on audit recommendations; a supplementary audit report will be provided with the auditors' response on observations/ views of client on audit recommendations. Final audit report will be the sum of originally submitted audit report (auditor's recommendations) and supplementary audit report (i.e., client's observations/ views on auditor's recommendations together with auditor's response on client's observations/ views on audit recommendations)

10. Implementing the Agreed Recommendations

Once the client has taken decision on the audit report and finalized the list of recommendations that are accepted and agreed, they need to be implemented. The designer has to develop design changing, which addresses the safety problems. If any serious problem is identified, temporary warning, delineation or other treatment may be needed until the agreed solution is implemented.

11. Completion Meeting

A completion meeting with the participation of the auditors, client and design team of client, if any, has to be organized in which the safety concerns, observations and perceptiveness of the auditors could be explained and discussed to understand the constraints and views of the client on those safety concerns, observations and recommendations. Salient issues discussed in brief may be brought out in the minutes of the meeting drawn by audit team.

Collection and Review of Documents and Maps

The consultant has requested RHD for the alignment drawings of the five project roads, however only the drawings of Joydebpur-Mymensingh Road Improvement Project (JMRIP) four lane road (recently completed) of Raymoni-Mymensingh section could be made available to them. Google maps were used to obtain firsthand information on the alignment and surroundings of the road which would be validated during field survey. Information on crashes on the project corridors has been collected from Accident Research Institute (ARI) and being analyzed. Road geometric data like length, width, LRP (Location Referencing Point), traffic data (AADT) etc. were collected from Road Maintenance Management System (RMMS) of RHD website. Traffic survey reports on these corridors have been collected and being reviewed. The documents used are:

- Crash data collected from Accident Research Institute
- Traffic data collected from Road Maintenance Management System (RMMS) database of RHD
- Drawings of JMRIP: Construction of Raymoni-Mymensingh Section (Chainage: km 59+850 to km 87+179)

Road Safety Checklist

The checklist proposed in the methodology has been tested in the field. Considering the local road and roadside scenario, the checklist has been revised. Also to make it more effective, the checklist has been plotted in the diagram:

Night Time Visibility

As a part of road safety audit, team also traveled the road length at night to see the night time visibility in the road, especially in the built-up area.

Checklist for Night Time Audit

Checklist for Night Time Audit (For each 10 km)			
Team:			
Chainage :			
Issue	Yes	No	Comment
Is lighting required? (see night time pedestrian movement and business activities)			
Is the road free of trees, over bridges etc. which interrupt illumination?			
If lighting provided, is it adequate?			
Is the road free of lighting pole in road area/ median area without safety barrier?			
Are the appropriate types of poles used for all locations and correctly installed (e.g. slip-base at correct height, rigid poles protect if within clear zone)?			
Is the lighting creating confusion on signs and signals?			

Figure 4.3: Checklist for Night Time Audit



5th
CHAPTER
RESULTS

SITE DETAILS



N1

CHATTOGRAM - COX'S BAZAR

(131KM WITH 100M INTERVAL ON BOTH SIDES OF THE ROAD)

Chattogram-Cox'sBazar Highway (N1)

Surveyed Length: 131km with 100m interval on both sides of the road

Salient Features of the Study Segment of N1

The N1 (Dhaka–Chattogram) Highway, length 462.25km, is a main transportation artery in Bangladesh, between Dhaka and Chattogram. This road links the country's two largest cities, Dhaka and Chattogram. The highway is known along various stretches as the Chattogram–Cox'sBazar Highway and the Cox'sBazar–Teknaf Highway. The road safety audit was conducted during 11 May to 24 May, 2018. The road mainly is a 2 lane highway with average width of around 6m with no NMT line. The road has a standard shoulder of 1.5m and verge/earthen shoulder of 1m.

Road infrastructures details are:

- Major bridges (lengths more than 100m): 3 numbers
- Minor bridges (lengths less than 100m): 29 numbers
- Culverts: 143 numbers
- Bus lay bays: 6 numbers

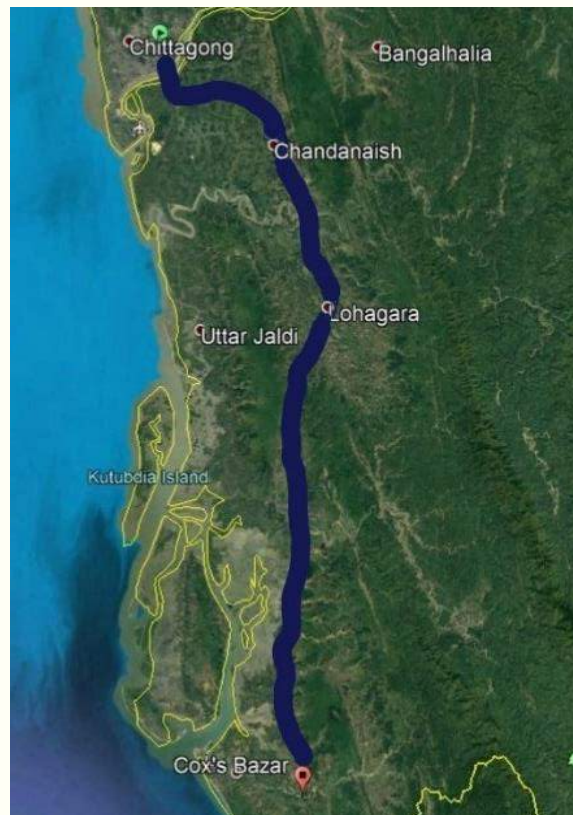


Figure 5.1: Road Section of Chattogram-Cox'sBazar Highway (N1)

[Source: Google Earth]

Traffic Data

N1 is the busiest road in the country and a top development priority. The AADT (Average Annual Daily Traffic) of this road is 23272 (Motorized: 21961, Non-Motorized: 1312). A typical section of the survey area shows increasing trend of traffic demand.

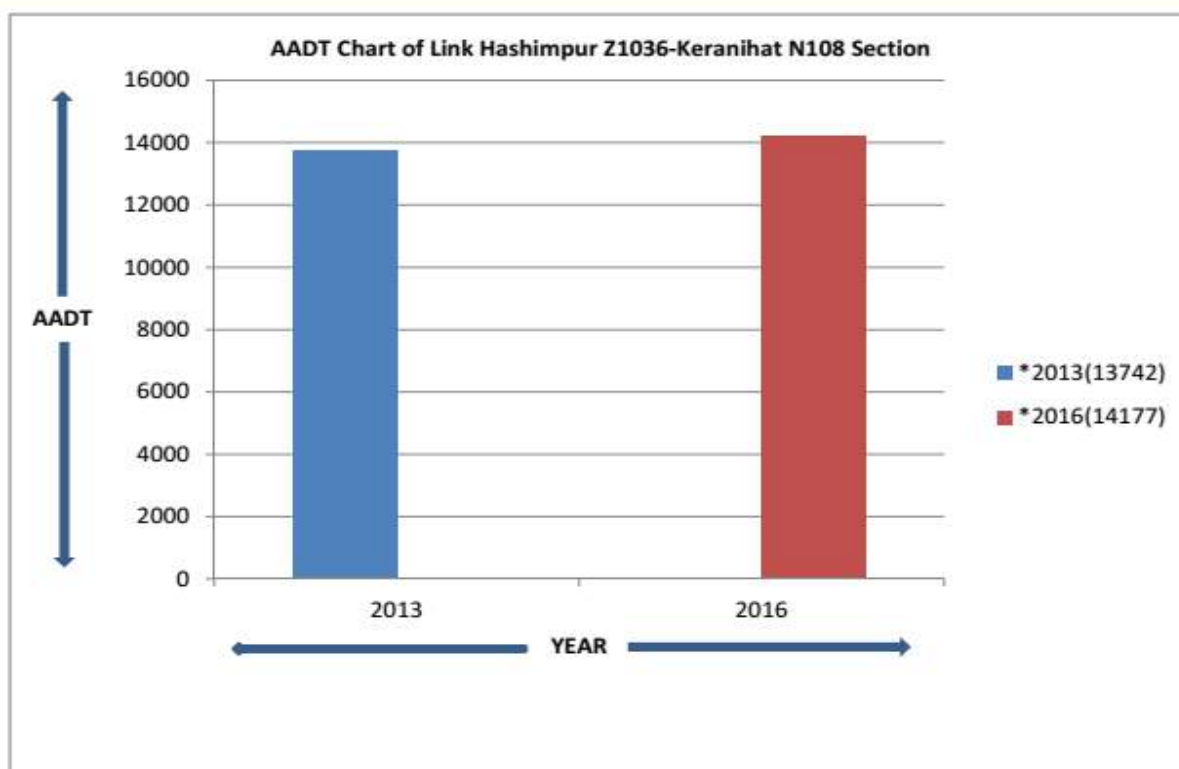


Figure 5.2: AADT Demand Situation on Chattogram-Cox'sBazar Highway (N1)
[Source: RMMS (www.rhd.gov.bd/RoadDatabase)]

Road Traffic Injury and Crash Data

Police reported injury and crash statistics (2011-2015) based on statistical analysis shows that since 2011, about 28 crashes were responsible for about 70 fatalities on this highway section of 148km. So, almost 1 fatality occurs in each 2km of the surveyed section. The most dominant crash type on this section was head on collision (46%), hit pedestrian (21%) and others consisted the rest 33%. Geometrical feature, overtaking tendency on this mostly single carriageway highway is the prime cause of high head on collision percentage. The geometrical crash study indicated that 79% crashes took place in the straight sections of the highway compared to only 11% on curves, which referred to the high speed and reckless driving as major concerns for treatment of the highway

Audit Findings

Audit team omitted 10.5km (Ch.+240km- Ch.+250.5km) and surveyed rest of the 131 km. The site which was omitted was under construction and hence it was deducted after consultation with RHD. For detailed study and further research regarding N1 highway, check ANNEXURE-C and ANNEXURE-D for specific information.

N1

a. Road Side Hazards

- Roadside hazards were those temporary /permanent structures along the road which might increase crash severity if hit by vehicle. Audit team considered 2m width after the pavement and counted permanent / temporary structures, trees (diameter more than 6cm) and steel poles.
- Roadside clear zone occupied by temporary structure 1km (0.8%) on left side during journey from Chattogram to Cox'sBazar. From Cox'sBazar to Chattogram, temporary structures occupied 2.7km (2%) whereas permanent structures (mainly concrete structures) occupied around 1.1km (0.8%) roadside length.
- Combining both sides, surveyed road of N1 consisted 31 trees and 149 poles within 2m from hard shoulder edge.
- Average 1 roadside hazard on every 1.25km and maximum 23 hazards on every 10km were identified on Chattogram- Cox'sBazar Highway. Along the Cox'sBazar to Chattogram side, average 1 roadside hazard on every 0.8km and maximum 18 hazards on every 10km were identified.

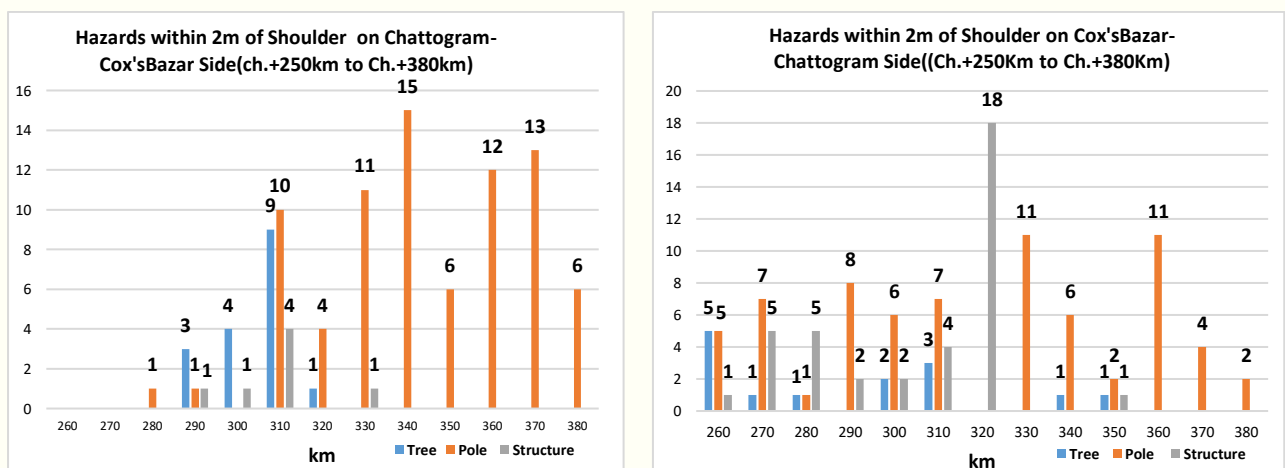


Figure 5.3: Hazards within 2m of Shoulder on Chattogram-Cox'sBazar Highway (N1) (Both Sides)

- On Chattogram-Cox'sBazar highway, 33.4 km (25.5%) verge/earthen shoulder was either missing or less than standard dimension of 1m for any emergency traffic movement. 16.5km (12.47%) was found waterlogged, 1.6km (1.21%) was covered by bushes and 16.9km (12.77%) was occupied by parked vehicles, materials and garbage. A total of 43.6km (32.96%) earthen shoulder was found sufficient (at least 1m width) but 20.3km (15.34%) had highly risky edge drop (more than 3-inch height) which were creating traffic vulnerability.
- On Cox'sBazar- Chattogram highway, 31.6km (21%) earthen shoulder was either missing or less than standard dimension of 1m for any emergency traffic movement. 24.5km (16%) was waterlogged, 13.9km (9%) was covered by bushes and 15.9km (8%) was occupied by parked vehicles, materials and garbage. Out of total, 131km earthen shoulder, 27.3km (18%) was sufficient (at least 1m width) but 30.9km (21%) having risky edge drop were creating traffic vulnerability.
- Immediate measure required chainages of roadside hazards are given in ANNEXURE-A.

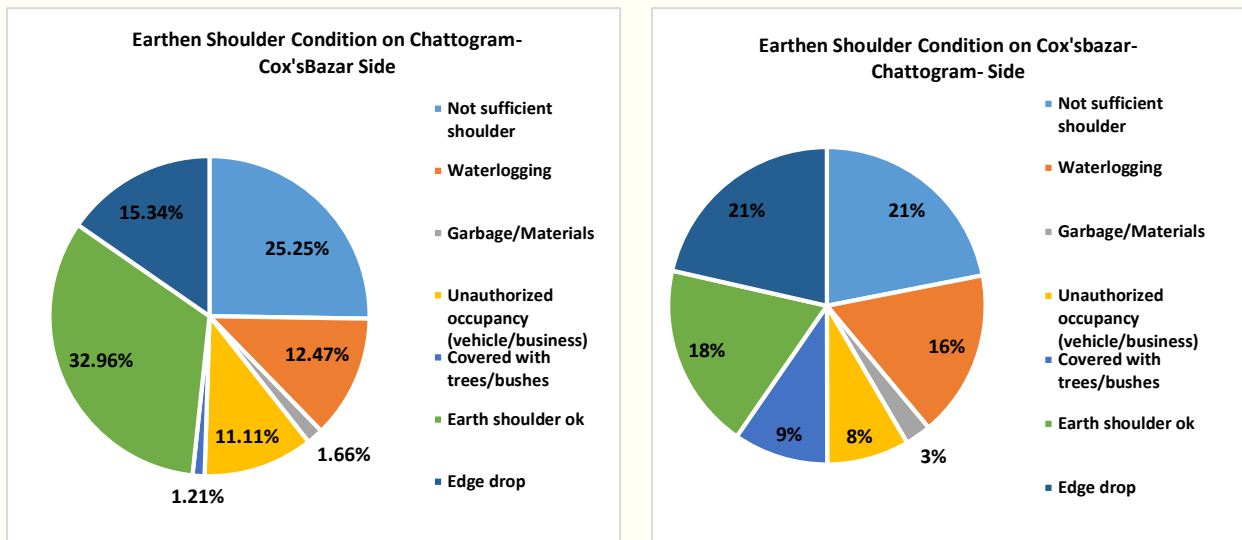


Figure 5.4: Earthen Shoulder Condition on Chattogram-Cox'sBazar Highway (N1) (Both Sides)

b. Signs

- Necessary regulatory, warning and information signs were not in place. Existing signs were not quite conspicuous and clear. In some cases, no regulatory, warning or information signs was placed. Sometimes non-

conventional signs were placed at the center of carriageway without any engineered treatment

- A total of 218 signs were found in both sides of the highway which were mainly B10, B10R, B12, B13, B25 etc.
- Some of the existing signs were not visible due to roadside activities such as roadside shops, billboards on street parking, temporary gate installed on the road etc. Some signs were not at all visible due to vegetation and some were not visible from a distance due to vegetation. Some signs were ineffective and illegible due to faded color in the background, letters, signs and borders. Team observed 50 signs (N.B: ANNEXURE-A) having such problems.
- According to BRTA manual, for an 80km speed highway, the sign should be placed 150m far from object which was not seen in most of the cases along the road length. Team found a total of 19 signs (N.B: ANNEXURE-A) which were very close from the hazard and very hard to understand by moving traffic.
- Audit team suggested to put additional 1930 signs along the highway which were required but missing and mandatory to make the road safer which were mainly A1, B31, B10, B3, C2 etc. A list of additionally required signs suggested by audit team and immediate sign required locations has been given in the ANNEXURE-A.
- The team explored total number of 1999 signs that needs to be prepared/ installed.

c. Pavement Stature

- 141.1 km (87.1%) of the pavement of 131km was workable whereas 13.1km (9.9%) was distressed 1.8 km (1.4%) pavement had potholes (N.B: ANNEXURE-A) which were creating serious vulnerability.
- 1.85km pavement found waterlogged. (N.B: ANNEXURE-A)

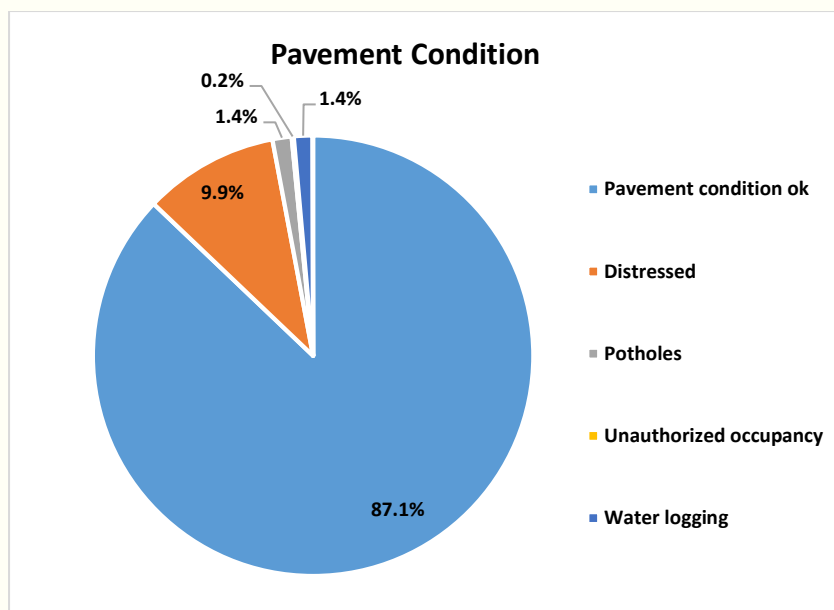


Figure 5.5: Pavement Condition on Chattogram-Cox's Bazar Highway (N1)

- The roadway had 26.3km sharp curve region which were very risky as delineation in all section was very poor.
- Almost 98km on left side of Chattogram-Cox's Bazar Highway had inadequate hard shoulder width (less than 1.5m) which did not meet RHD standard though 34km shoulder was properly maintained. On the right side of Chattogram-Cox's Bazar, 86.6km had inadequate hard shoulder and rest section was found appropriate as per design standard.
- Visible road marking was found on only 19km of the total survey length. Although overall marking situation was poor but from Chokoria to Cox's Bazar road section (Ch.+313km to Ch.+345km) was well maintained. The curve sections had wrong road marking (dotted line instead of solid/no overtaking line). Centerline road marking was visible but needs maintenance as they were being faded and edge lines got faded on most of the road length.
- Speed bump were found on 19 locations of the survey length which did not meet the standard of RHD design guideline (for 50 kmph, length should be 9.5 m and height 10cm). Those should be treated immediately. Only 3 of them had advanced warning sign whereas all of them should have advanced warning sign.
- Median was not found in this survey area.

d. Parking Facilities

Survey team found 55 locations where road was being occupied by illegal road side parking which indicates the necessity of formal parking facility along the roadside. Only 1 formal parking was found where the team suggested to provide parking facilities in 2 locations immediately (Ch.+344.6, Ch.+344.7) to reduce side friction of vehicles and for better traffic movement control by avoiding congestion.

e. Bus Bay

The surveyed length had 6 bus bays, for 3(N.B: ANNEXURE-A) of them width was not adequate according to guideline, minimum width of the bus bay should be 3.7m in addition to main carriageway. There was no advanced sign in the bus bays but all bus bays had extra lane and acceleration/deceleration lane. The survey team suggested bus bays in 25 new locations (N.B: ANNEXURE-A) for better road capacity and traffic safety for both buses and passengers.

f. Bridges/Culverts

The survey team found 143 culverts, 27 small span bridges (less than 100m length) and 3 medium sized (length in between 100m and 500m) bridges. Among those bridges/culverts, 19 did not have any provision to walk on footpath which insisting pedestrian to walk through the main carriageway which needed immediate attention. 43 of all the structures had working guard rail/post whereas 34 had disturbed due to previous collision with it or construction decay. Reflector was not available in 169 and only 8 of them had proper pedestrian facilities. Practice of hazard sign was not found on any of the bridges/culverts.

g. Intersections

A total number of 125 intersections were found on the surveyed length all of which were un-channelized. All the un-channelized intersections were at right angle. Among the junctions, 42 had steep slope which needed to be treated immediately. Corner radius was not provided in 95 of them and, only 1 had speed change lanes. There was no advanced warning sign or stop sign in side road among the surveyed intersections. Out of all intersections, 58 were not clearly visible from the main road which might cause crashes. Only 5 intersections had pedestrian facilities.

h. Built-up Areas

The team addressed roadside business areas which were unauthorized as most of them were situated very close to the road, although according to the law, there would not be any business activity within 10m of the roadside area. Among the surveyed length, 16.1km was marked as built-up area in 37 locations (N.B: ANNEXURE-A), and none of them had any welcome sign or speed limit sign or speed calming devices. Only 10% areas had good pedestrian facilities. The dominating structure in these areas was concrete structure. Vehicle type in these areas was mixed though bus was rapidly used mode of transport. Maximum size of built-up area was 3.6km between chainage 261km-264km.

i. School Zones

44 school zones were marked during the survey and the number of students were approximately in between 300-1500 in each school. Though they were adjacent to the highway but none of them had any speed calming device, warning sign even no pedestrian facility like zebra crossing.

j. Night Visibility

Overall night visibility situation was poor throughout the N1 survey section. Sufficient lighting was required on this surveyed length particularly on built-up areas. However, light was present in sections where construction was going on roads and bridges. There was no formal lighting facility provided along this road section. The built-up areas, CNG/petrol stations, hotels were found with minimal /required lighting. These built-up areas were observed both day and night survey and a combined list is provided in the ANNEXURE-A. Signs were not reflective at night, other than the one with visibility problem (cannot be seen at all during night), most signs had low visibility and almost no reflection capacity. In most cases, signs remained unreadable even from certain distance. Road centerline was visible but faded parts on most of the road length rendered it useless. Road edge lines were visible where given but in most part got faded or shadowed by surroundings.

Recommendations for Highway N1

The audit team observed that most of the road corridor has become chaotic due to lack of highway access management, that is why an overall highway access

management suggestion in being given in the conclusions section. The major mitigation measures required for highway N1 is given below:

✓ **Immediate measures**

- It will involve restoration of 184.6 km shoulder on both sides of the Highway N1 as per standard design. Also, 15.5 km removal of roadside (both sides) vegetation which reducing shoulder width and obstructing visibility should be removed immediately. 51.2 km of high drop-offs at shoulders should be removed all along the highway
- Fixation of 50 sign posts which have visibility issue and 19 signs to maintain distance from object as per design guideline. As per audit team suggestion, 1930 additional signs should be installed.
- Installation of 112km of pavement markings, improving 16.1km delineation of built-up areas, improvement of pedestrian facilities, installation of bus bays at 25 warranted locations, strengthening enforcement, and safety campaign to local communities.
- Detail engineering studies are suggested to establish/enforce appropriate special speed limits/speed zoning for the Built-up Areas/Bazaars.
- 180 roadside hazards/ objects within 2 m of carriageway should be removed immediately.
- A total number of 125 junctions were found on the surveyed length of which 42 had steep slope which needs to be treated immediately. At all junctions, approaching minor road should be aligned at a right angel to major road. Also, the intersections should be fully signed in accordance with the RHD standards.
- Among the 173 bridges/culverts, 19 did not have any provision to walk on footpath which insisting pedestrian to walk through the main carriageway that needed immediate attention as per required design. Count of pedestrian and NMV traffic would be useful in determining the seriousness of this hazard. If the footpath is not feasible, an attempt should be made to encourage vehicles to slow down using signs, markings and warning driver by rumble strips.
- The audit team suggested to provide parking facilities in 2 locations immediately (Ch.+344.6 km, Ch.+344.7km).

N1

- Of the 44 school zones close to the highway, all require speed management, warning sign and pedestrian facility like zebra crossing/foot over bridge.

Immediate measures should be taken within a year (based on detail investigation comprising of traffic survey, topographic survey and community feedback for pedestrian crossings).

✓ **Midterm measures**

Based on further investigation, It will consist of provision of speed change lane at junctions including channelization where required, provision of truck stands, service roads in built-up areas (following the principles of the highway access management policy), channelization of junctions, provision of right turn lane through widening road sections (where right turning volume is high), pedestrian over bridge and provision of overpass at very congested location to facilitate movement of through traffic. Midterm measures will not be required where RHD has a program to upgrade the road to dual carriageway within next two years.

✓ **Long-term measures**

It will consist of provision of grade separation at important junctions, underpass for pedestrians, flyover at congested part of built-up areas, and separate lane for slow moving vehicles based on further study on the highway. Long term measures are proposed where upgrading to dual carriageway is not up-coming within next five years.

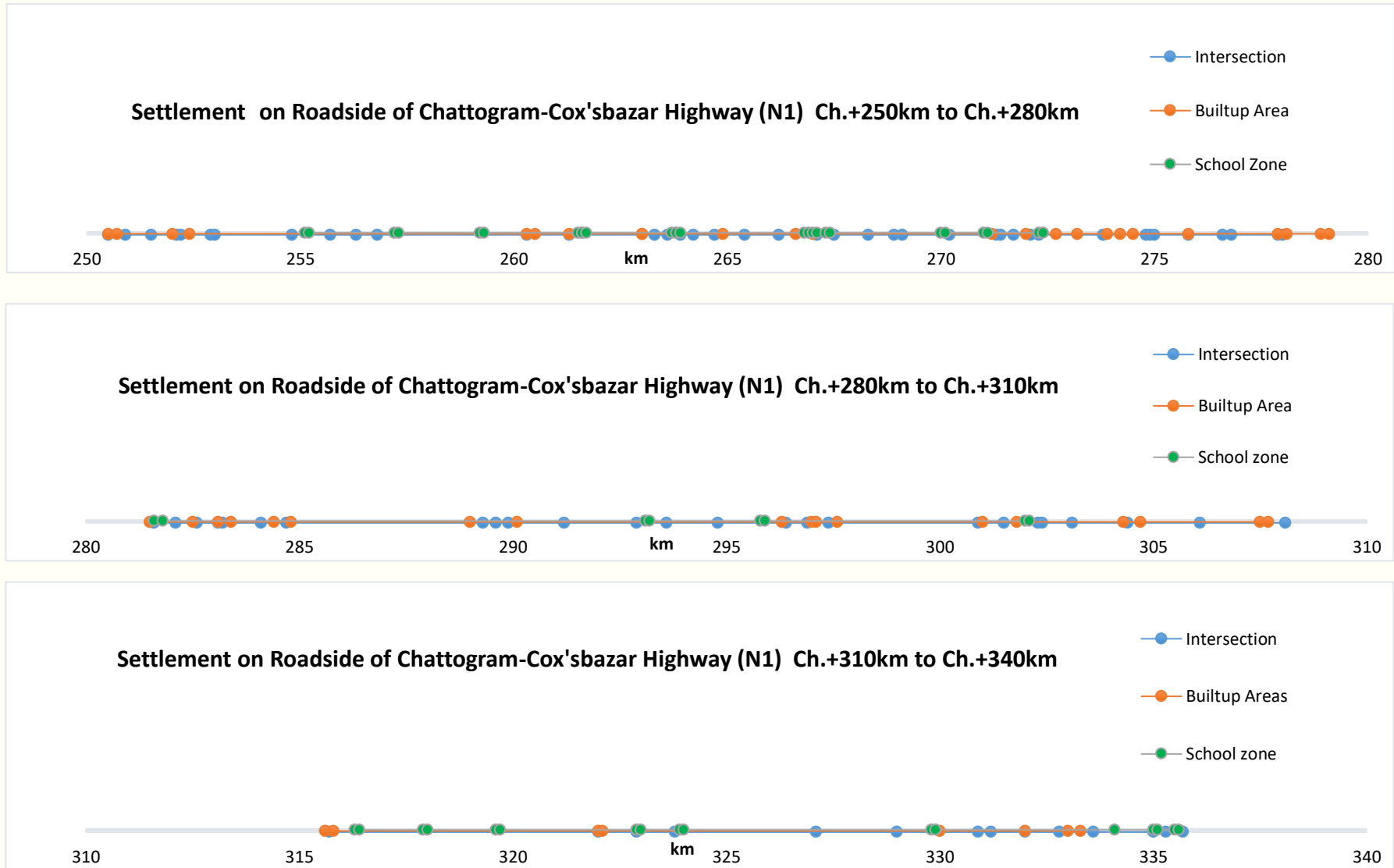


Figure 5.6a: Intersections, Built-up Areas and School Zones on Chattogram-Cox'sBazar Highway (N1)

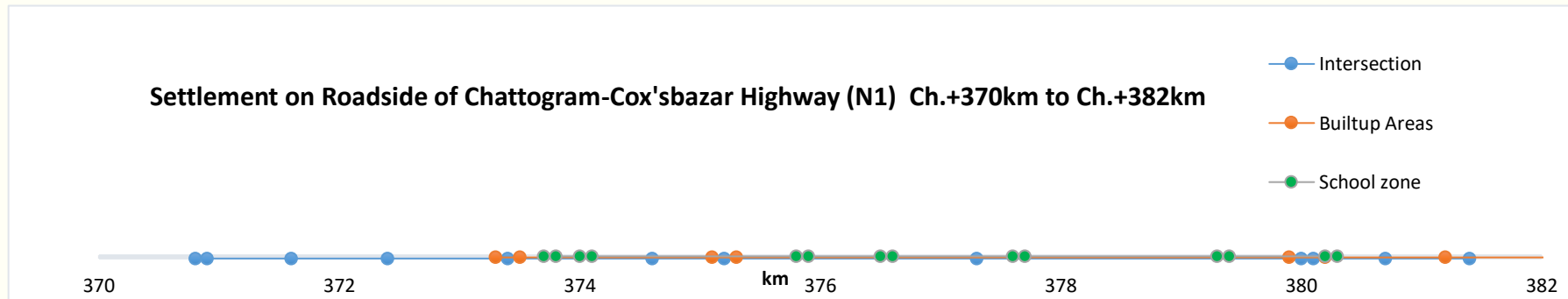
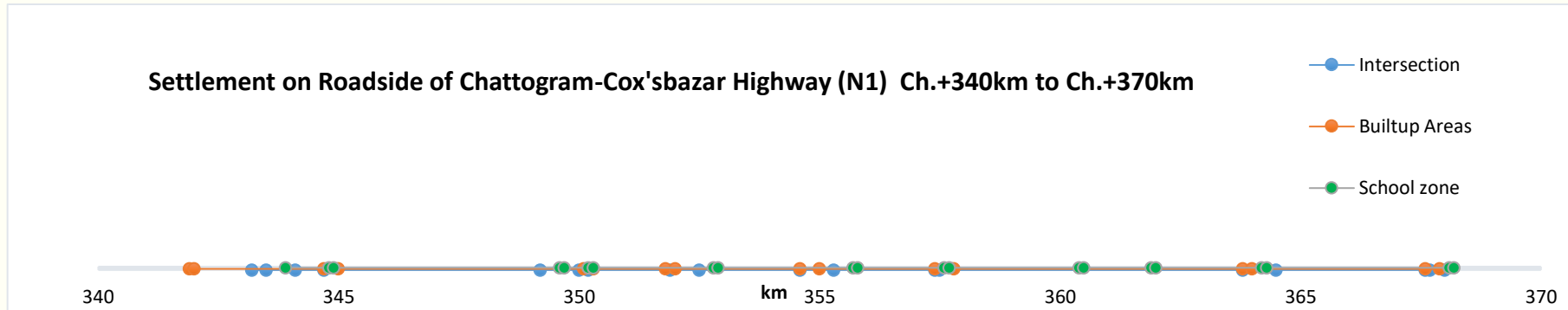


Figure 5.6b: Intersections, Built-up Areas and School Zones on Chattogram-Cox'sBazar Highway (N1)



Illegal roadside activity within Ch.+ 252.5 to Ch.+255



Defective shoulder due to rain within Ch.+252.5 to Ch.+255



Y-intersection without warning sign within Ch.+255 to Ch.+257 causing high risk



Road sign within Ch.+255 to Ch.+257 is not clear



Poor visibility of road sign within Ch.+257 to Ch.+259



Unauthorized roadside activity within Ch.+ 259 to Ch.+261



Unauthorized risky parking and shoulder drop within Ch.+ 261 to Ch.+263



Disturbed road sign at Ch.+ 265 to Ch.+267



Defective road sign at Ch.+269 to Ch.+271



Unauthorized roadside business within clear zone at Ch.+ 271 to Ch.+272



Roadside bushes occupying earthen shoulder at Ch.+ 272 to Ch.+274



Unknown road sign at Ch.+274.5 to Ch.+276.5



No warning sign and marking across the bridge within.Ch.+287 to Ch.+289



Inadequate shoulder within Ch.+293 to Ch.+295



Less visible road sign at Ch.+295 to Ch.+297



Unknown road sign within clear zone at Ch.+ 297 to Ch.+299



Risky shoulder drop at Ch.+299 to Ch.+301



Unauthorized roadside business within Ch.+ 301 to Ch.+303



Less visible road sign at Ch.+311 to Ch.+313



Roadside business in shoulder within Ch.+321 to Ch.+323



Risky concrete pole on shoulder within Ch.+323 to Ch.+325



Sign covered by roadside business , creating serious obstruction within Ch.+329 to Ch.+331



Bridge having no footpath and delineation at Ch.+ 331 to Ch.+333



Unauthorized dumping within Ch.+331 to Ch.+333



Illegal truck parking within Ch.+331 to Ch.+333



Water logging at Ch.+ 331 to Ch.+333



Bus parking within Ch.+333 to Ch.+335 in an illegal manner



Below standard zebra crossing without speed calming arrangement within Ch.+ 335 to Ch.+337



Blockage in the road side area by unauthorized business within Ch.+ 343 to Ch.+345



Disturbed concrete pole at Ch.+ 355 to Ch.+357



Curve section without chevron sign at Ch.+369 to Ch.+371



Number of banners in roadside area creating visibility obstruction within Ch.+ 381 to Ch.+383

SITE DETAILS



N6

KASHINATHPUR - RAJSHAHI HIGHWAY
(146.9KM WITH 100M INTERVAL ON BOTH SIDES OF THE ROAD)

Kashinathpur - Rajshahi Highway (N6)

Surveyed Length: 146.9km with 100m interval on both sides of the road

Salient Features of the Study Segment of N6

The N6 Highway, length 232.24km, is a major transportation artery in Bangladesh, between Kashinathpur and Rajshahi. The road safety audit was conducted from 11 May to 24 May, 2018. The road mainly is a 2 lane highway with average width of 7.3m with no NMT line. The road has a standard shoulder of 1.5m and verge/earthen shoulder of 3m.

Road infrastructures details are:

- Roundabouts: 11 numbers
- Major bridges (lengths more than 100m): 2 numbers
- Minor bridges (lengths less than 100m): 14 numbers
- Culverts: 86 numbers
- Bus lay bays: 14 numbers

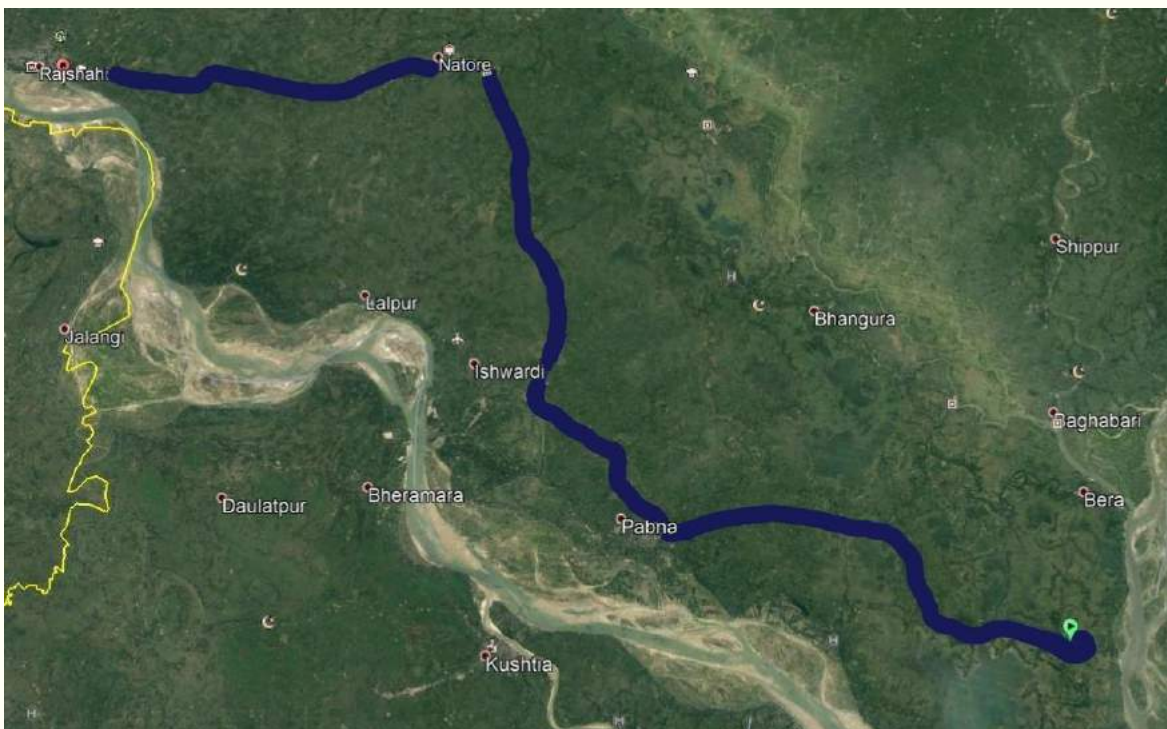


Figure 5.7: Road Section of Kashinathpur - Rajshahi Highway (N6) [Source: Google Earth]

Traffic Data

N6 is one of the busiest roads in the country and a top development priority. The AADT (Average Annual Daily Traffic) of this road is 14011 (Motorized: 11292, Non-Motorized: 2719); A typical section of the survey area shows increasing trend of traffic demand.

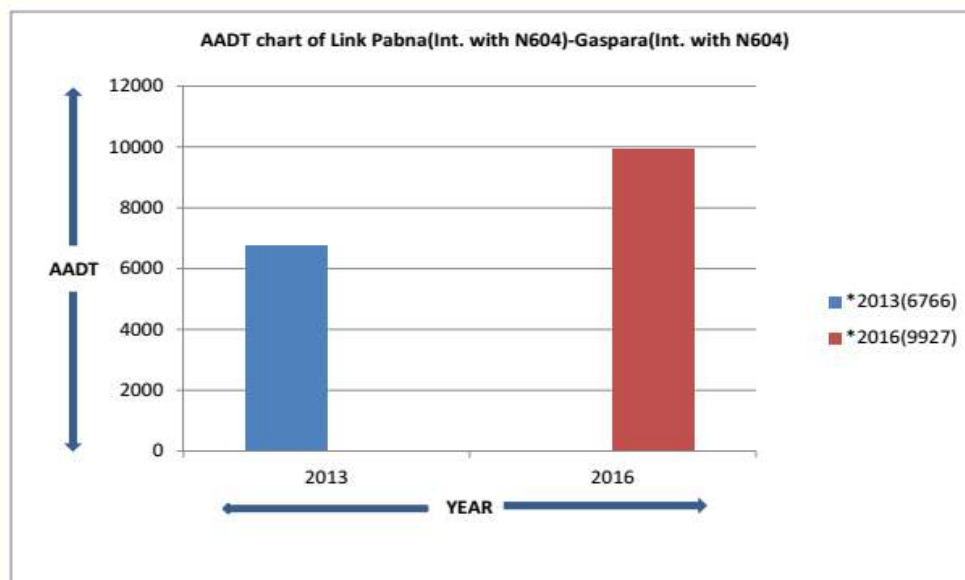


Figure 5.8: AADT Demand Situation on Kashinathpur - Rajshahi Highway (N6)
[Source: RMMS (www.rhd.gov.bd/RoadDatabase/)]

Road Traffic Injury and Crash Data

Police reported injury and crash statistics (2011-2015) based on statistical analysis shows that since 2011, about 31 crashes were responsible for about 64 fatalities among which 38 were fatal on this highway section on 148.3km. So, almost 1 fatality occurs in each 2km of the surveyed section. The most dominant types crash on this section were head on collision (42%), hit pedestrian (29%), rear end collision (16%) and others consisted the rest 13%. Geometrical feature, overtaking tendency on this mostly single carriageway highway is the prime cause of high head on collision percentage. The geometrical crash study indicated that 84% crashes took place in the straight sections of the highway compared to only 16% on curves which referred to the high speed and reckless driving as major concern for treatment of the highway.

Audit Findings

Out of 148.3 targeted survey length, the survey team omitted 1.4km (Ch.+142.6km-Ch.+144km) and surveyed rest of the 146.9km. The site which was omitted was

under construction and hence it was deducted after consultation with RHD. For detailed study and further research regarding N6 highway, check ANNEXURE-C and ANNEXURE-D for specific information.

a. Road Side Hazards

- Roadside hazards were those temporary /permanent structures along the road which might increase crash severity if hit by vehicle. Audit team considered 2m width after the pavement and counted permanent / temporary structures, trees (diameter more than 6cm) and steel poles.
- Roadside clear zone occupied by temporary structures 1.2km (0.8%) and permanent structures 3.6km (2.51%) on left side during journey from Kashinathpur to Rajshahi. On the way from Rajshahi to Kashinathpur, temporary structures occupied 2.3km (1.6%) whereas permanent structures (mainly concrete structures) occupied around 6.3 km (4.4%) of the roadside length.
- Combining both sides, surveyed road of N6 consisted of 44 trees and 92 poles within 2m from hard shoulder edge.
- Average 1 roadside hazard on every 1.40km and maximum 29 hazards on every 10km were identified on Kashinathpur to Rajshahi Highway. On the other side, on Rajshahi - Kashinathpur Highway, average 1 roadside hazard on every 0.8km and maximum 37 hazards on every 10km were identified.

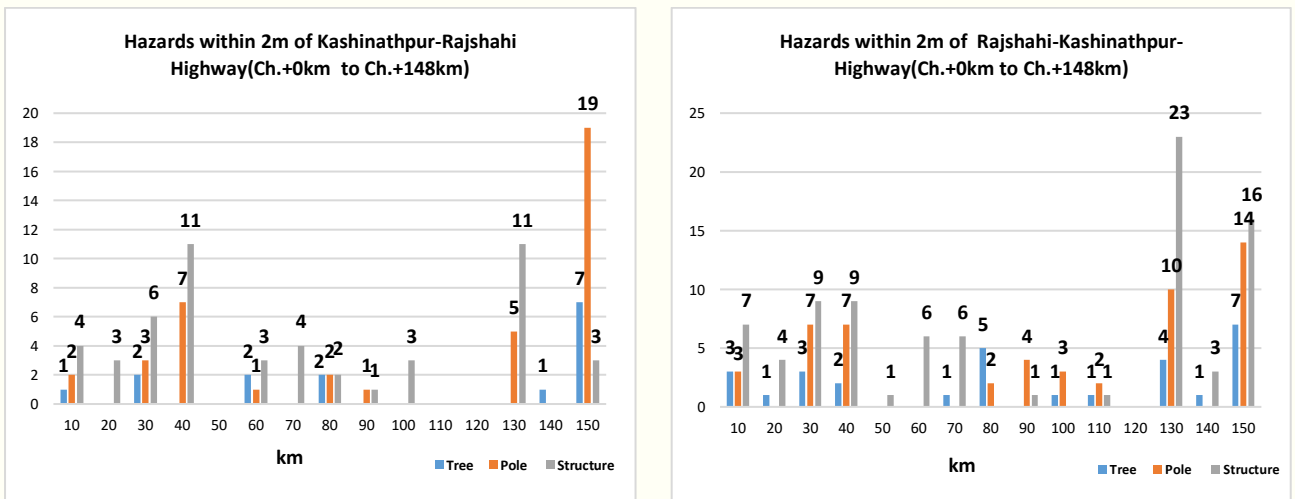


Figure 5.9: Hazards within 2m of Kashinathpur - Rajshahi Highway (N6) (Both Sides)

- On Kashinathpur-Rajshahi Highway, 6.6km (4.44%) verge/earthen shoulder was either missing or less than standard dimension of 1m for any emergency

traffic movement. 7.9km (5.32%) was found waterlogged, 20km (13.47%) was covered by bushes and 20.5km (13.8%) was occupied by parked vehicles, materials and garbage. A total of 89.3km (60.13%) earthen shoulder was found sufficient (at least 1m width) but 4.2km (2.83%) had highly risky edge drop (more than 3-inch height) which were creating traffic vulnerability.

- On Rajshahi-Kashinathpur Highway, 7.2km (5%) earthen shoulder was either missing or insufficient for any emergency traffic movement. 9km (6%) was waterlogged, 52.3km (35%) was covered by bushes and 33.2km (22%) was occupied by parked vehicles, materials and garbage. Out of total, 131km earthen shoulder, 42.4km (28%) was sufficient but 5.5km (4%) had risky edge drop which were creating traffic vulnerability.
- Immediate measure required chainages of roadside hazards are given in ANNEXURE-A.

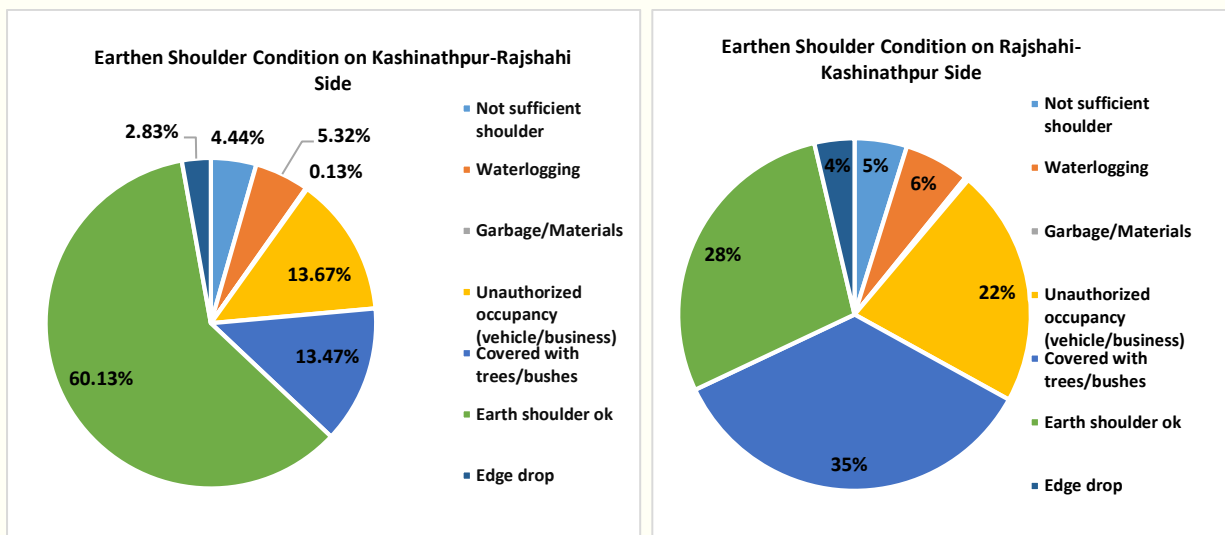


Figure 5.10: Earthen Shoulder Condition on Kashinathpur - Rajshahi Highway (N6) (Both Sides)

b. Signs

- Necessary regulatory, warning and information signs were not in place. Existing signs were not quite functioning and clear. In some cases, no regulatory, warning or information signs were placed. Sometimes non-conventional signs were placed at the center of carriageway without any engineered treatment.
- A total of 124 signs were found in both sides of the highway which were mainly A20, A26, B10, B36, B31, C21 etc.

- Some of the existing signs were not visible due to roadside activities, such as, roadside shops, billboards on street parking, temporary gate installed on the road etc. Some signs were not at all visible due to vegetation and some were not visible from a distance due to vegetation. Some signs were ineffective and illegible due to faded color in the background, letters, signs and borders. Team observed 51 signs (N.B: ANNEXURE-A) having such problems.
- According to BRTA manual, for an 80km speed highway, the sign should be placed 150m far from object which did not meet in most of the cases along the road length. Team found a total of 18 signs (N.B: ANNEXURE-A) which were very close to the hazard and very hard to understand by moving traffic.
- Audit team suggested to put additional 3041 signs along the highway which were required but missing and mandatory to make the road safer which were mainly B3, B10, B4, B13, C4 etc. A list of additionally required signs suggested by audit team and immediate sign required locations has been given in the ANNEXURE-A..
- 10 signs were found broken which were rendered as useless as there was only the stand available and no sign on it.
- The team observed a total number of 3120 signs needed to be prepared/ installed.

c. Pavement Stature

- Among 146.9km pavement 118 km (79.7%) was workable whereas 26.5km (18.6%) was distressed.1.8 km (1.4%) pavement had potholes(N.B: ANNEXURE-A) which were creating serious vulnerability.
- 1.14km pavement found waterlogged (N.B: ANNEXURE-A), 4.2km was illegally occupied by vehicles, unauthorized maintenance work etc.
- 17km was made of Harrington brick road instead of flexible pavement.

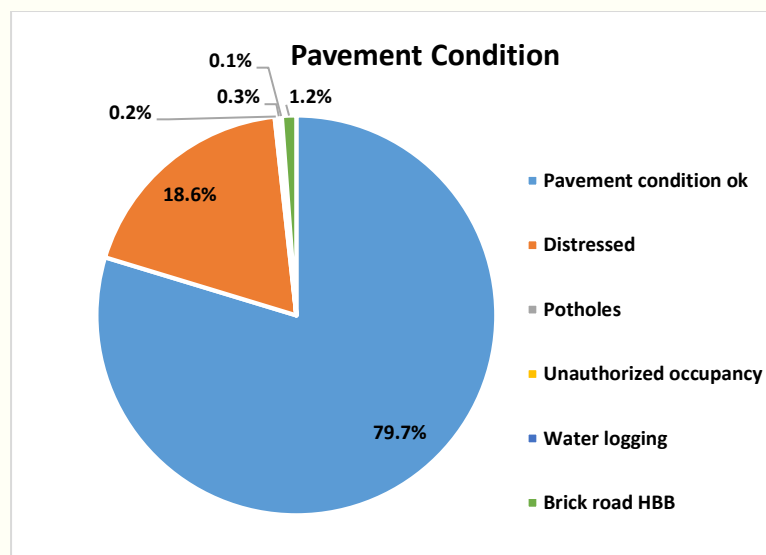


Figure 5.11: Pavement Condition on Kashinathpur - Rajshahi Highway (N6)

- The roadway had 11.4km sharp curve region which were very risky as delineation in all section were very poor.
- Almost 42.2km on Kashinathpur-Rajshahi Highway had inadequate hard shoulder width (less than 1.5m) which did not meet RHD standard though 32.7km hard shoulder was properly maintained. On the left side (Rajshahi-Kashinathpur), 56.2km had inadequate shoulder and rest section was appropriate.
- Visible road marking was found on only 40km of the total survey length. Centerline road marking was visible but needed maintenance as they were being faded and edge lines got faded on most of the road length.
- Speed bump were found on 20 locations of the survey length which did not meet the standard of RHD design guideline (for 50 kmph, length should be 9.5 m and height 10cm). Those should be treated immediately. Only 7 of them had advanced warning sign whereas all of them should have advanced warning sign.
- Median was found in 8.1km of the total survey length whereas 8km had standard width and height (standard is 0.6m width and minimum .15m height), 4.8km had bushes and 100m had unauthorized structures on the median and 7.2km had adequate painting. In 12 points U-turn signs were provided.

d. Parking Facilities

Survey team found 184 locations where road was being occupied by illegal road side parking which indicated the necessity of formal parking facility along the roadside. Only 1 formal parking was found there whereas the team suggested to provide parking facilities on 1 location immediately (Ch.+ 9.5km) to reduce side friction of vehicles and for better traffic movement control by avoiding congestion.

e. Bus Bay

The surveyed length had 15 bus bays whereas 4 of them were not being used and 6 were illegally occupied (N.B: ANNEXURE-A). Among all these 15 available bus bays, 1 had advanced sign, 11 had extra lane and 7 had acceleration/deceleration lane facility. The survey team suggested to have bus bays on 15 (N.B: ANNEXURE-A) new locations for better road capacity and traffic safety.

f. Bridges/Culverts

The survey team found 86 culverts, 14 small span bridges (less than 100m length) and 2 medium size bridge (length in between 100m and 500m). Among those bridge/culverts, 102 had standard width. Only 1 of all the structures had working guard rail/post whereas 18 had disturbed guard rail/post due to previous collision or construction decay, reflector was not available in 102 and only 24 of them had proper pedestrian facilities among which 19 were in poor condition. Practice of hazard sign was not found on any of the bridges/culverts.

g. Intersections

A total number of 217 intersections were found on the surveyed length whereas 4 were channelized, 202 were un-channelized and 11 were roundabout. Among the intersections, 175 were at right angle, 14 were 45 degree angle and 2 were Y-junction. Among the junctions, 7 had steep slope which needed to be treated immediately. Corner radius was not provided in 46 of them and, 17 had speed change lanes. There was warning sign in only 15 intersections among the surveyed intersection. Out of all intersection, 11 intersections were not clearly visible from the main road which might cause crashes. Only 8 intersections had pedestrian facilities.

Among the 11 roundabouts, corner radius was not provided in 1 and 10 had speed changing lanes. Only 2 intersections of these 11 had pedestrian facilities.

h. Built-up Areas

The team addressed roadside business areas which were unauthorized as most of them situated very close to the road, although according to the law, there would not be any business activity within 10m of the roadside area. Among the surveyed length, 28.7 km was marked as built up area in 37 locations (N.B: ANNEXURE-A), 81% had no welcome/ warning sign, 73% had no stop sign, 86% had no calming device, 90% had no pedestrian facilities. The dominating structure in these areas was concrete structure. Vehicle type in these areas was mixed though bus was rapidly used mode of transport. Maximum size of built-up area was 3.2km between chainage 41.4km-44.6km.

i. School Zones

53 school zones were marked during the survey and the number of students were approximately in between 300-2000 in each school. Though the schools were adjacent to the highway but only 2 of them had speed calming device, warning sign and pedestrian facilities like zebra crossing.

j. Night Visibility

Overall night visibility was poor throughout the surveyed section. Sufficient light was required on this survey length particularly on built-up areas. However, enough lighting was present on sections Ch.+0km-8km, one side on Ch.+10km to +Ch.11km and discreet lighting between Ch.+62 to Ch.+70km and in some sections there was pole but no light (probably stolen). Other than mentioned before, there was no formal lighting found on this road section. The built-up areas, CNG/petrol stations, hotels illumination were the lighting source on this road. These built-up areas were marked during both day and night survey and a combined list was provided in the ANNEXURE-A and required attention for formal lighting. Signs were not retro-reflective, other than the one with visibility problem (could not be seen at all during night), most signs had low visibility. In most cases, signs remained unreadable even from a close distance. Road centerline was visible but faded parts on most of the road length rendered it useless. Road edge lines were visible where given but in most part got faded or shadowed by surroundings.

Recommendations for Highway N6

The audit team observed that most of the road corridor has become chaotic due to lack of highway access management, that is why an overall highway access

management suggestion in being given in the conclusions section. The major mitigation measures required for highway N6 is given below:

✓ **Immediate measures**

- It will involve restoration of 98.4 km shoulder on both sides of the Highway N6 as per standard design. Also, 70.3 km removal of roadside (both sides) vegetation which reducing shoulder width and obstructing visibility should be removed immediately. 9.7 km of high drop-offs at shoulders should be removed all along the highway
- Fixation of 51 sign posts which have visibility issue and 18 signs to maintain distance from object as per design guideline. As per audit team suggestion, 3041 additional signs should be installed.
- Installation of 106.9 km of pavement markings, improving 28.7 km delineation of built-up areas, improvement of pedestrian facilities, installation of bus bays at 15 warranted locations, strengthening enforcement, and safety campaign to local communities.
- Detail engineering studies are suggested to establish/enforce appropriate special speed limits/speed zoning for the Built-up Areas/Bazaars.
- 136 roadside hazards/ objects within 2 m of carriageway should be removed immediately.
- A total number of 217 junctions were found on the surveyed length of which 7 had steep slope which needs to be treated immediately. At all junctions, approaching minor road should be aligned at a right angel to major road. Also, the intersections should be fully signed in accordance with the RHD standards.
- Among the 102 bridges/culverts, 78 did not have any provision to walk on footpath which insisting pedestrian to walk through the main carriageway that needed immediate attention as per required design. Count of pedestrian and NMV traffic would be useful in determining the seriousness of this hazard. If the footpath is not feasible, an attempt should be made to encourage vehicles to slow down using signs, markings and warning driver by rumble strips.
- The audit team suggested to provide parking facilities in 1 locations immediately (Ch.+ 9.5km)

- Of the 53 school zones close to the highway, all but 2 require speed management, warning sign and pedestrian facility like zebra crossing/foot over bridge.

N6

Immediate measures should be taken within a year (based on detail investigation comprising of traffic survey, topographic survey and community feedback for pedestrian crossings).

✓ **Midterm measures**

Based on further investigation, It will consist of provision of speed change lane at junctions including channelization where required, provision of truck stands, service roads in built-up areas (following the principles of the highway access management policy), channelization of junctions, provision of right turn lane through widening road sections (where right turning volume is high), pedestrian over bridge and provision of overpass at very congested location to facilitate movement of through traffic. Midterm measures will not be required where RHD has a program to upgrade the road to dual carriageway within next two years.

✓ **Long-term measures**

It will consist of provision of grade separation at important junctions, underpass for pedestrians, flyover at congested part of built-up areas, and separate lane for slow moving vehicles based on further study on the highway. Long term measures are proposed where upgrading to dual carriageway is not up-coming within next five years.

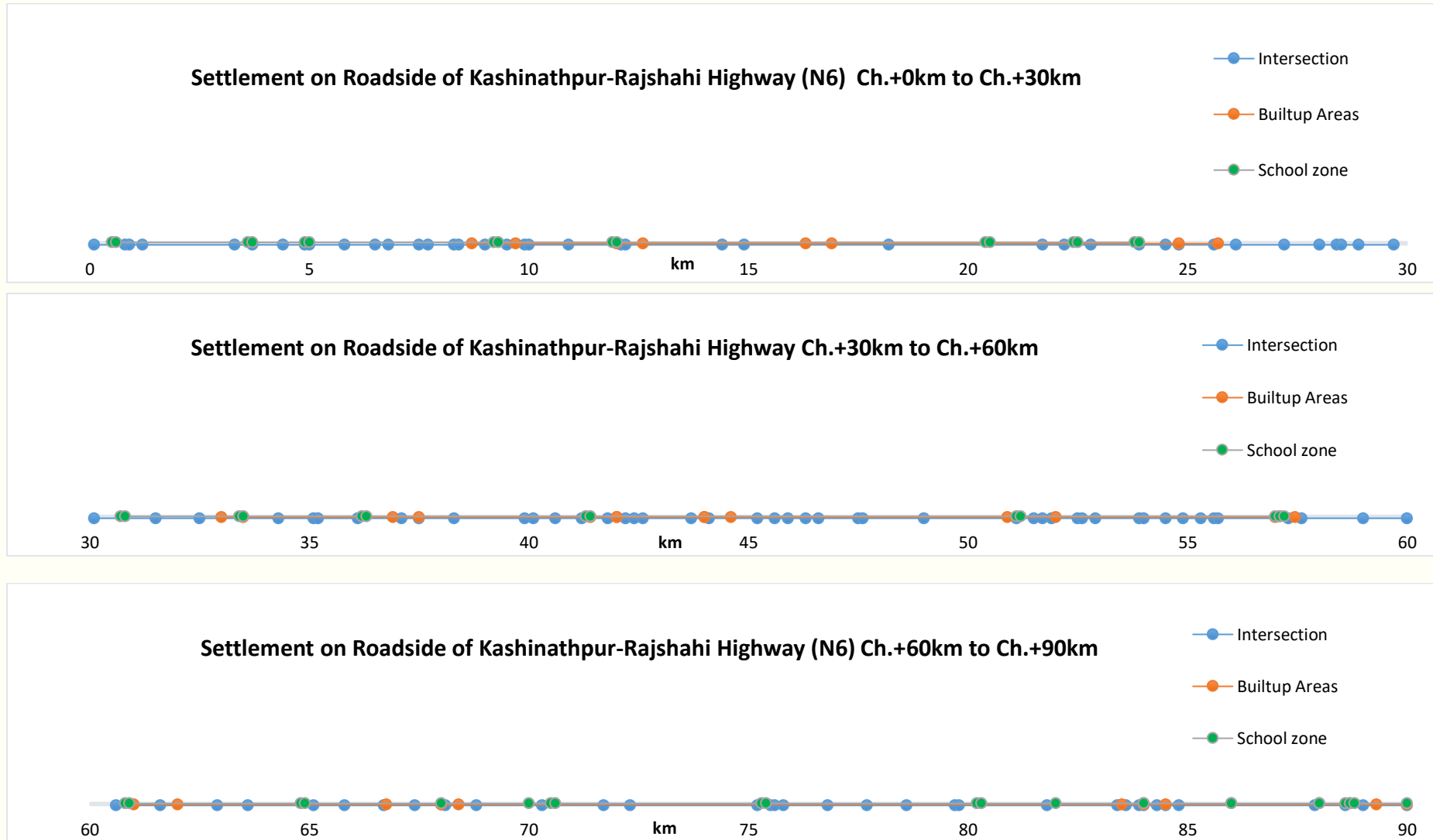


Figure 5.12a: Intersections, Built-up Areas and School Zones on Kashinathpur - Rajshahi Highway (N6)

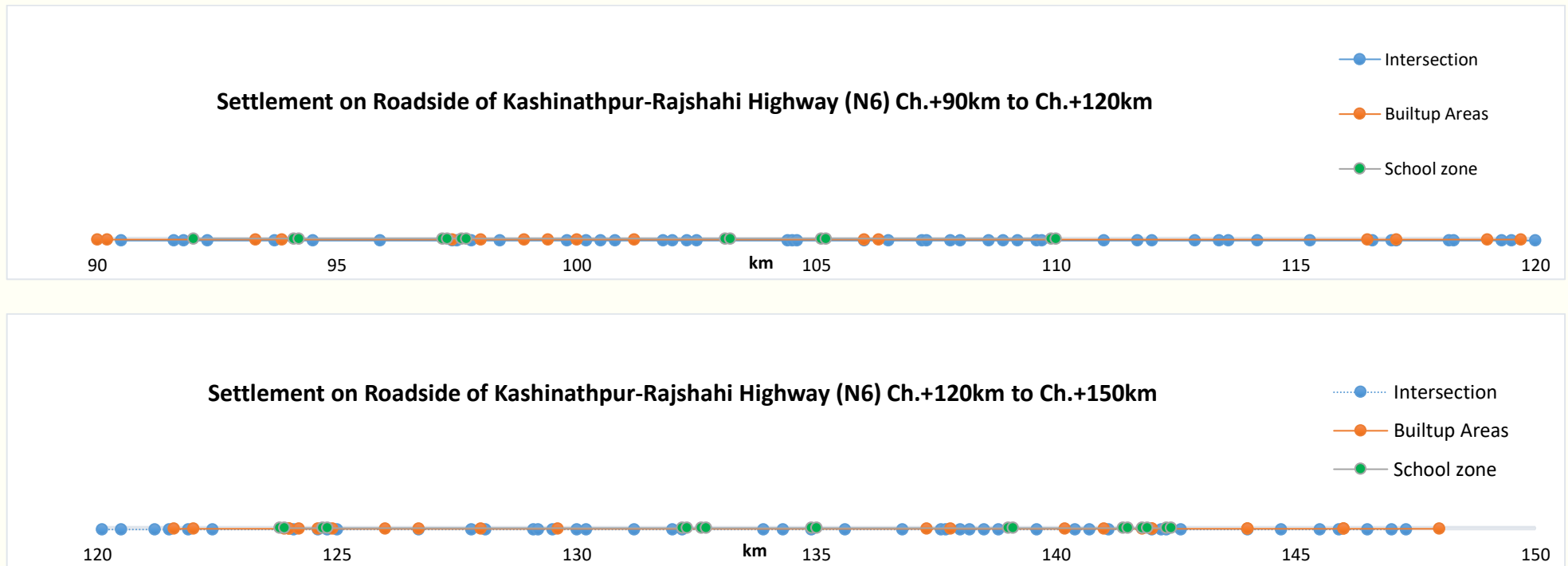


Figure 5.12b: Intersections, Built-up Areas and School Zones on Kashinathpur - Rajshahi Highway(N6)

N6



Unauthorized roadside activity within Ch.+8 to Ch.+10



Warning sign post in shoulder within Ch.+10 to Ch.+12



No marking and sign at barrier within Ch.16 to Ch.+18



Lack of shoulder forcing pedestrian to walk on carriageway within Ch.+18 to Ch.+20



Illegal roadside activity within Ch.+ 22 to Ch.+24



Risky shoulder drop within Ch.+26 to Ch.+28



Construction materials over carriageway are kept illegally within within Ch.+28 to Ch.+30



Side road without proper treatment within Ch.+ 30 to Ch.+32



Unauthorized roadside business within Ch.+ 32 to Ch.+34



Poor pavement and shoulder within Ch.+36 to Ch.+38



Shoulder within Ch.+46 to Ch.+48 at a risky condition



Defective shoulder at Ch.+48 to Ch.+50



Unauthorized roadside activities within Ch.+50 to Ch.+52



Roadside bushes within Ch.+58 to Ch.+60



Confusing sign within Ch.+ 60 to Ch.+62



Unauthorized roadside parking within Ch.+72 to Ch.+74



Unauthorized road side activities within Ch.+72 to Ch.+74



Risky, unknown sign post within clear zone within Ch.+ 72 to Ch.+74



Distressed pavement within Ch.+74 to Ch.+76



Defective and risky shoulder at Ch.+ 84 to Ch.+86



Broken sign within Ch.+84 to Ch.+86



Faded sign within Ch.+84 to Ch.+86



Unknown and disturbed km sign post within Ch.+84 to Ch.+86



Disturbed sign within Ch.+96 to cjh.+98



Unauthorized parking within Ch.+ 98 to Ch.+100



Side road without advanced warning sign within Ch.+106 to Ch.+108



Disturbed road sign within Ch.+110 to Ch.+112



Pavement without DBS within Ch.+ 118 to Ch.+120



Wrong dimension of road sign within Ch.+124 to Ch.+126



Wrong dimension of road sign within Ch.+130 to Ch.+132



Unauthorized zebra crossing without traffic calming device within Ch.+ 138 to Ch.+140



Wrong designed raised pedestrian crossing within Ch.+140 to Ch.+142



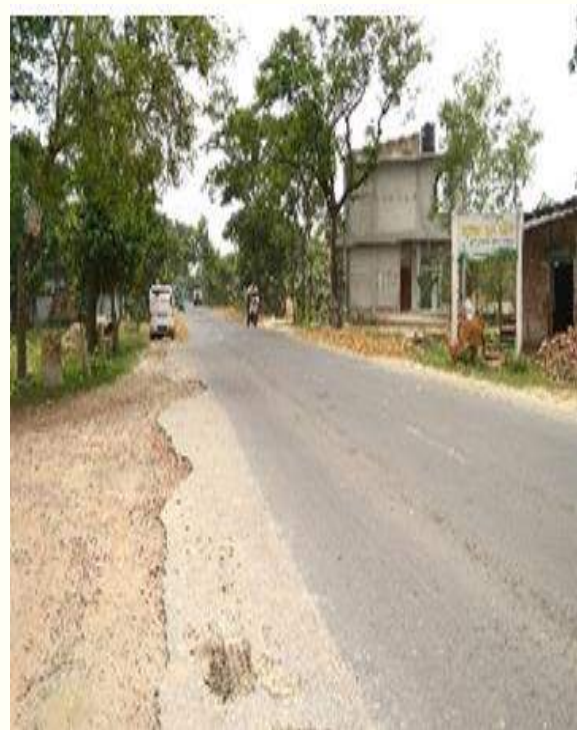
Wrong and risky construction practice within Ch.+142 to Ch.+144



Illegal roadside activity within Ch.+144 to Ch.+146

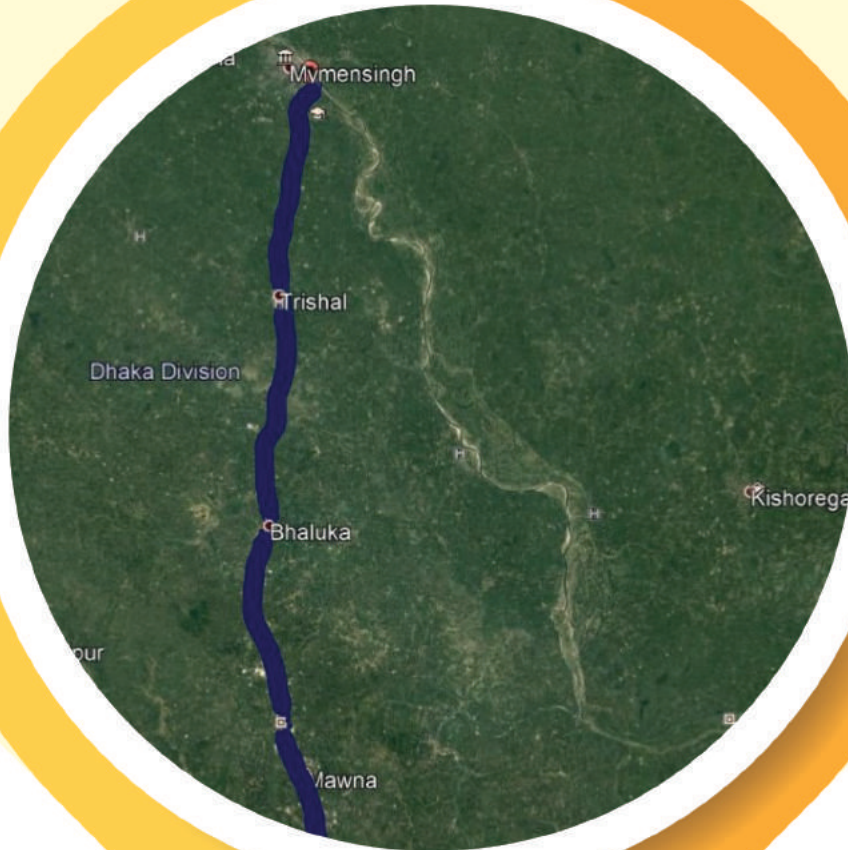


Defective shoulder within Ch.+74 to Ch.+76 causing risk



Broken and risky within Ch.+106 to Ch.+208

SITE DETAILS



N3

GAZIPUR - MYMENSINGH HIGHWAY
(88.4 KM ON BOTH SIDES OF THE ROAD)

Gazipur - Mymensingh Highway (N3)

Surveyed length: 88.4 km on both sides of the road

Salient Features of the Study Segment of N3

The N3 connects the capital Dhaka with Mymensingh. The highway has been considered as one of the major transport hazards, a man-made death traps owing to the frequency of fatal crashes. With the target of crash reduction and capacity increasing, the highway has been reconstructed to make 4 lanes, though crash is being happened frequently over the segment. The road safety audit was conducted from 1 June to 9 June 2018 on this highway road. The road mainly is a 4 lane highway with average width of 8m to 9m with no NMT line. The road had a standard shoulder of 1.5 m and verge/earthen shoulder of 1m.

Road infrastructures details are:

- Major junctions: 2 numbers
- Major bridges: 2 numbers
- Minor bridges :4 numbers
- Culverts: 120 numbers
- Bus lay bays: 21 numbers

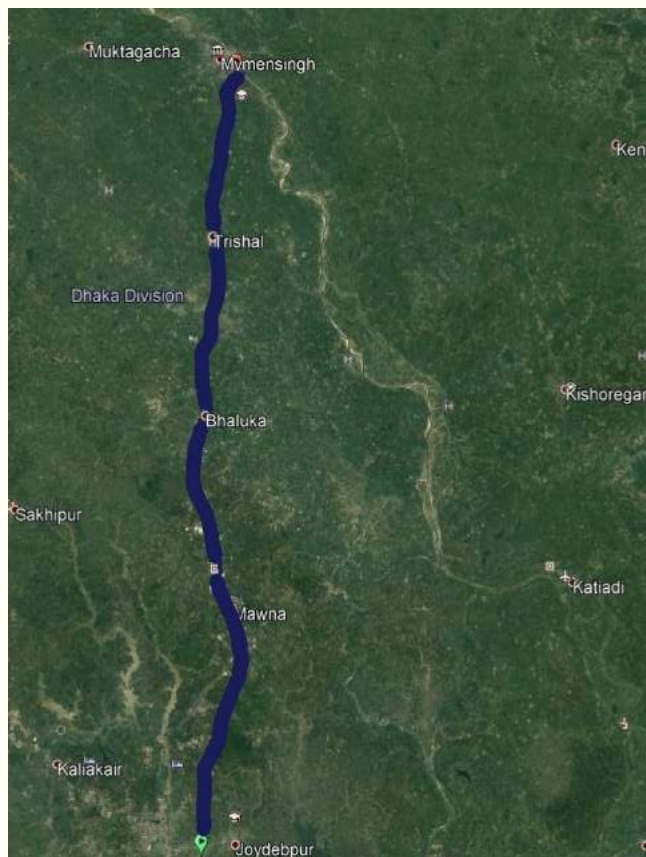


Figure 5.13: Road Section of Gazipur - Mymensingh Highway (N3)
[Source: Google Earth]

Traffic Data

N3 is one of the busiest roads in the country and a top development priority. The AADT (Average Annual Daily Traffic) of this road is 36637 (Motorized: 35018, Non-Motorized: 1619). A typical section of the survey area shows increasing trend of traffic demand.

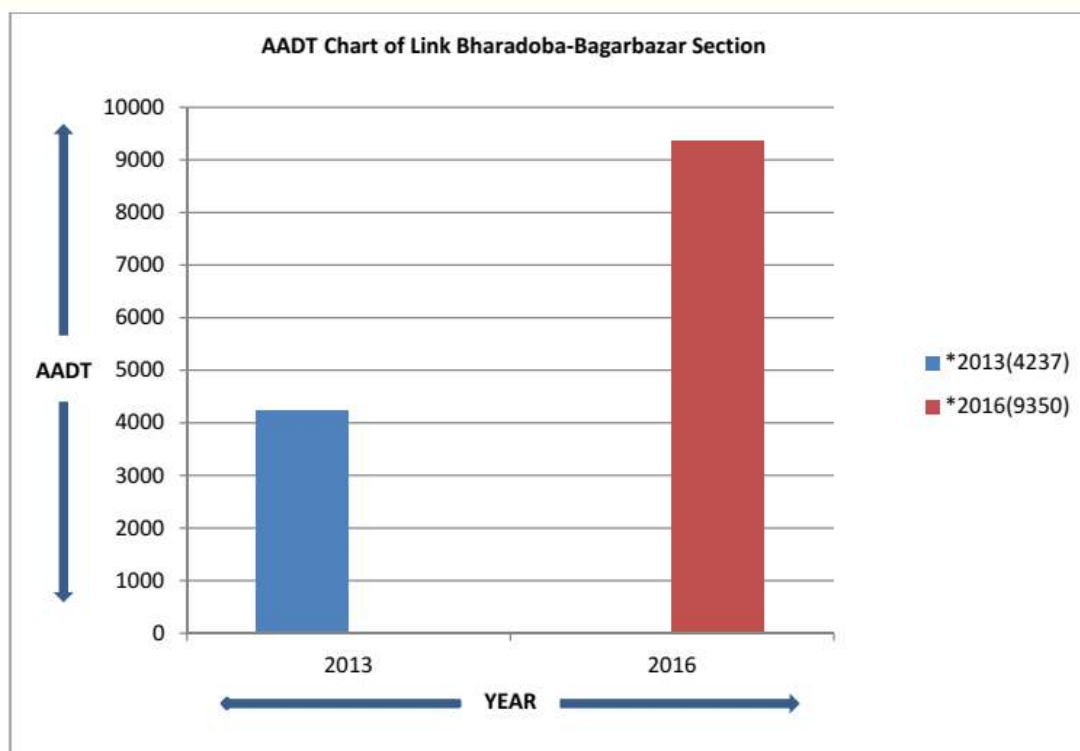


Figure 5.14: AADT Demand Situation on Gazipur-Mymensingh Highway (N3)
[Source: RMMS (www.rhd.gov.bd/RoadDatabase)]

Road Traffic Injury and Crash Data

Police reported injury and crash statistics (2011-2015) based on statistical analysis shows that since 2011, about 30 crashes were responsible for about 33 fatalities on this highway section 88.4 km. So almost 1 fatality occurred in each 2km of the surveyed section. The most dominant crash type on this section was hit pedestrians (50%), rear end collision (17%), others consisted the rest 33%. The geometrical feature encourages high speed and lack of enough pedestrian crossings/movement facilities along the dual carriageway highway is the prime reason of high hit pedestrian percentages. The geometrical crash study indicated that 97% crashes took place in the straight sections of the highway compared to only 3% on slope which referred to the high speed and reckless driving as major concern for treatment of the highway.

Audit Findings

For detailed study and further research regarding N3 highway, check ANNEXURE-C and ANNEXURE-D for specific information.

a. Road Side Hazards

- Roadside hazards were those temporary /permanent structures along the road which might increase crash severity if hit by vehicle. Audit team considered 2m width after the pavement and counted permanent/temporary structures, trees (diameter more than 6cm) and steel poles.
- Roadside clear zone occupied by permanent structure 2.8km (3.2%) on left side during journey from Gazipur to Mymensingh. On the road from Mymensingh to Gazipur, temporary structures occupied 0.1 km (0.1%) whereas permanent structures (mainly concrete structures) occupied around 1.8km (2%) roadside length.
- Combining both sides, surveyed road of N3 consisted of 2 trees and 117 poles within 2m from hard shoulder edge.
- Average 1 roadside hazard on every 0.9km and maximum 50 hazards on every 12km were identified on Gazipur to Mymensingh Highway. Along the Mymensingh to Gazipur side, average 1 roadside hazard on every 1.25km and maximum 43 hazards on every 10km were identified. Maximum road hazard was at the built-up area of Mymensingh city.

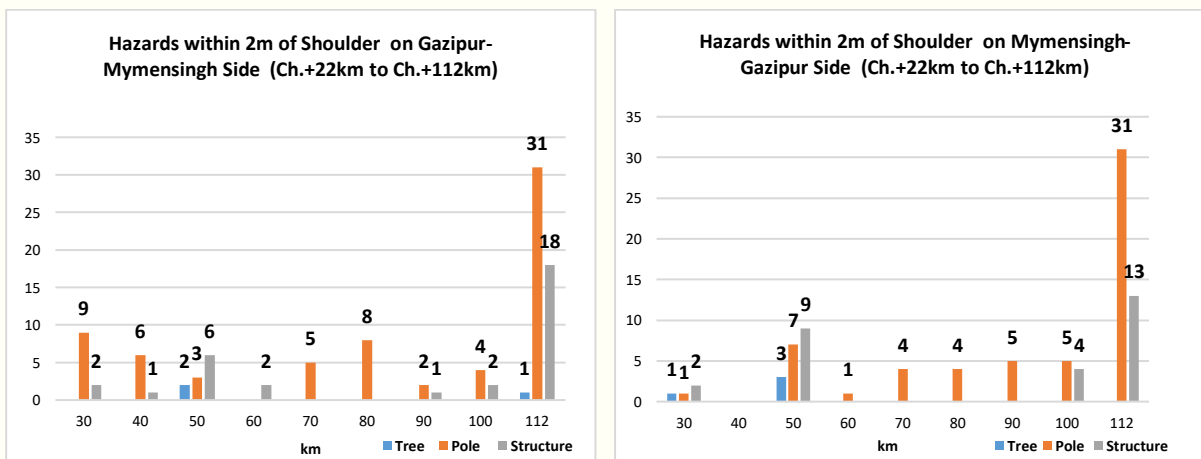


Figure 5.15: Hazards within 2m of Shoulder on Gazipur-Mymensingh Highway (N3) (Both Sides)

- On Gazipur-Mymensingh Highway, 13.6 km (12.02%) verge/earthen shoulder was either missing or less than standard dimension of 1m for any emergency traffic movement. 23.15km (20.47%) was found waterlogged,

12.9km (11.41%) was covered by bushes and 26.2km (23.22%) was occupied by parked vehicles, materials and garbage. A total of 36.17km (31.98%) earthen shoulder was found sufficient (at least 1m width) but 1.04km (0.92%) had highly risky edge drop (more than 3-inch height) which were creating traffic vulnerability.

- On Mymensingh-Gazipur Highway, 8.84km (10%) earthen shoulder was either missing or less than standard dimension of 1m for any emergency traffic, 18.1km (16%) was waterlogged, 14.7km (13%) was covered by bushes and 29.4km (26%) was occupied by parked vehicles, materials and garbage. Out of total 131km earthen shoulder, 39.6km (35%) was sufficient.
- Immediate measure required chainages of roadside hazards are given in ANNEXURE-A.

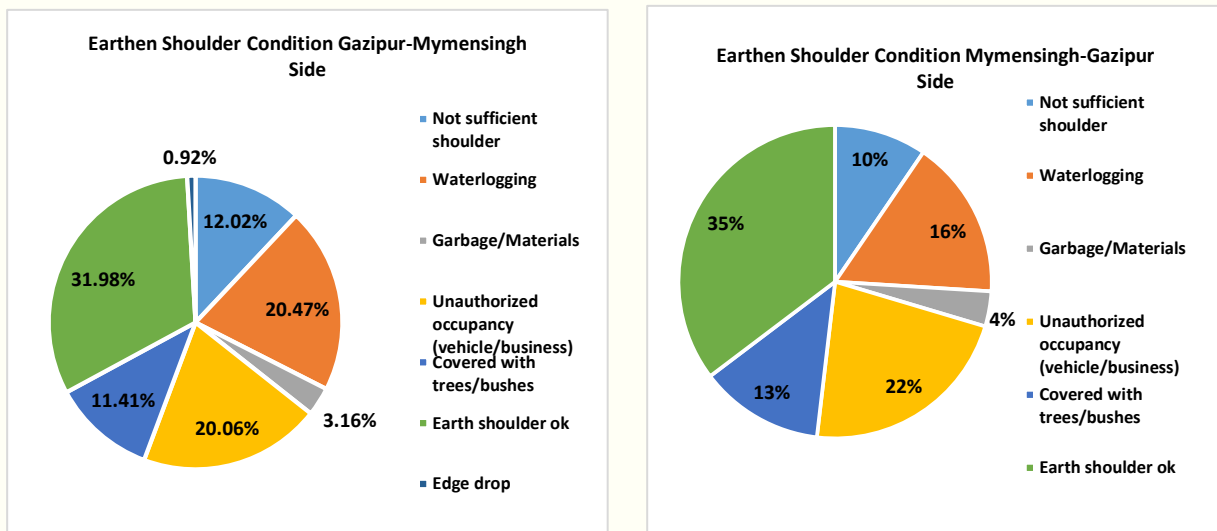


Figure 5.16: Earthen Shoulder Condition on Gazipur-Mymensingh Highway (N3) (Both Sides)

b. Signs

- Necessary regulatory, warning and information signs were not in place. Existing signs were not functioning and not clear. In some cases, no regulatory, warning or information signs were placed. Sometimes non-conventional signs were placed at the center of carriageway without any engineered treatment
- A total of 458 signs were found in both sides of the highway which were mainly B25, A26, A27, A33, A39, B1 etc.

- Some of the existing signs were not visible due to roadside activities, roadside shops, billboards on street parking, temporary gate installed on the road etc. Some signs were not at all visible due to vegetation and some were not visible from a distance due to vegetation. Some signs were ineffective and illegible due to faded color in the background, letters, signs and borders. Team observed 65 signs (N.B: ANNEXURE-A) having such problems.
- According to BRTA manual, for an 80km speed highway, the sign should be placed 150m far from object which did not meet in most of the cases along the road length. Team found a total of 5 signs (N.B: ANNEXURE-A) which were very close to hazard and very hard to understand by moving traffic.
- Audit team suggested to put additional 2161 signs along the highway which were required but missing and mandatory to make the road safer which are mainly A1, B31, B10, B3, C2 etc. A list of additionally required signs suggested by audit team and immediate sign required locations has been given in the ANNEXURE-A.
- 12 signs were found broken (N.B: ANNEXURE-A) which were rendered as useless as there was only the stand available and no sign on it.
- The team observed a total number of 2443 signs needed to be prepared/ installed.

c. Pavement Stature

- From Gazipur to Mymensingh Highway, among 88.4 km of the pavement, 86.1km (97.4%) was workable whereas 1.06km (1.2%) was distressed, 0.7 km (0.8%) pavement had waterlogging (N.B: ANNEXURE-A) which were creating serious vulnerability. On the other side, from Mymensingh to Gazipur Highway, among 88.4km the pavement of 86.3km (97.6%) was workable whereas 1.4km (1.6%) was distressed 0.2 km (0.2%) pavement had potholes (N.B: ANNEXURE-A) which were creating serious vulnerability.

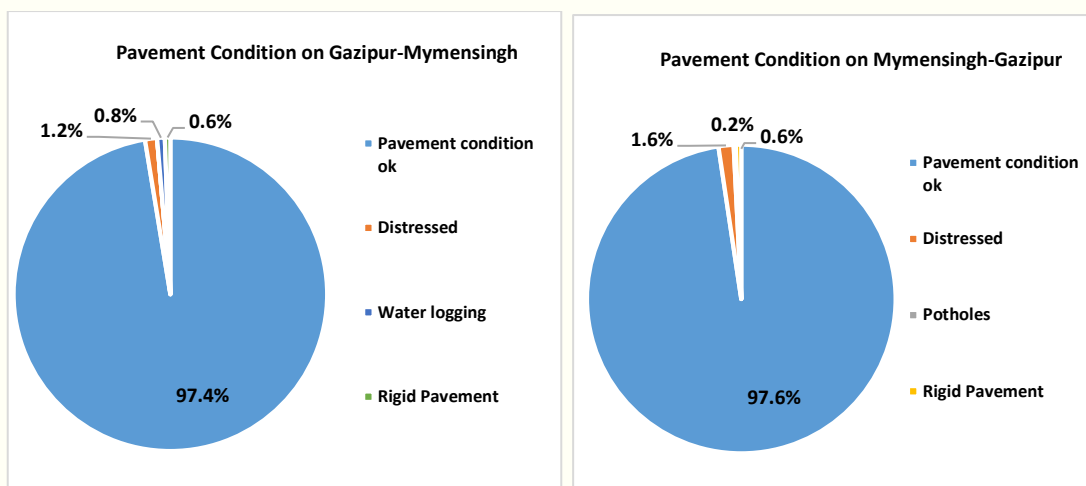


Figure 5.17: Pavement Condition on Gazipur-Mymensingh Highway (N3)

- The roadway had 7.5km sharp curve region which were very risky as delineation in all section were very poor.
- Almost 27.4km on left side of Gazipur-Mymensingh Highway had inadequate hard shoulder width (less than 1.5m) which did not meet RHD standard though 61km shoulder was properly maintained. On the right side of Gazipur-Mymensingh Highway, 21.4km had inadequate hard shoulder and rest section was found appropriate as per design standard.
- Road marking was found on only 83km of the total survey length. Centerline marking was in good condition throughout the road except Mymensingh district section from Ch.+105. Edge lines were in good condition but got faded in some sections. Pedestrian crossings paintings got faded in all cases on this highway.
- Speed bumps were found on 12 locations of the survey length which did not meet the standard of RHD design guideline (for 50 kmph, length should be 9.5 m and height 10cm). Those should be treated immediately. None of them had advanced warning sign whereas all of them should have advanced warning sign.
- Median was found in 80km of the total survey length whereas 78km had standard width and height, bushes and trees were present throughout them and 60 km had adequate painting. Reflector was used throughout this length but their reflecting ability was poor.

d. Parking Facilities

Survey team explored 409 locations where road was being occupied by illegal road side parking which indicates the necessity of formal parking facility along the road way. Only 8 formal parking were found.

e. Bus Bay

The surveyed length had 21 bus bays, most of their width was not adequate according to guideline (N.B: ANNEXURE-A), minimum width of the bus bay should be 3.7m in addition to main carriageway. There were advanced signs on 11 of the bus bay but 20 bus bay had extra lane and 15 had acceleration/deceleration lane. The survey team suggested bus bays in 4 new locations (N.B: ANNEXURE-A) for better road capacity and traffic safety.

f. Bridges/Culverts

The survey team observed 120 culverts, 2 small span bridges (less than 100m length) and 4 medium sized (length in between 100m and 500m) bridges. Among those bridges/culverts, 123 did not have any provision to walk on footpath which insisted pedestrian to walk through the main carriageway which needed immediate attention. 18 of all the structures had working guard rail/ post whereas 102 was disturbed due to previous collision with it or construction decay. Reflector was not available in 126 and only 3 of them had proper pedestrian facilities. Practice of hazard sign was not found on any of the bridges/culverts.

g. Intersections

A total number of 193 intersections were found on the surveyed length where none was channelized, 191 were un-channelized and 2 were roundabouts. Among the intersections, 179 were at right angle, 10 were on 45 degree angle or Y-junction. Among the junctions, 26 had steep slope which needed to be treated immediately. Corner radius was not provided in 130 of them and 1 had speed change lanes. Among the surveyed intersections, there was warning sign in only 45 intersections among the surveyed intersections. Out of all intersections, 12 intersections were not clearly visible from the main road which might cause crashes. Only 1 intersection had pedestrian facilities.

Among the 2 roundabouts, corner radius was not provided in 1 and, 1 had speed changing lanes. Only 1 intersection of these 2 was having pedestrian facilities.

h. Built-up Areas

The team addressed roadside business areas which were unauthorized as most of them were situated very close to the road. According to the law, there should not be any business activity within 10m of the roadside area. Among the surveyed length, 16.5km was marked as built-up area in 24 locations (N.B: ANNEXURE-A), and 20% of them had welcome sign or speed limit sign and only 33% had speed calming devices. Only 88% areas had pedestrian facilities but in poor condition. The dominating structure in these areas was concrete structure. Vehicle types in these areas were mixed though bus was rapidly used mode of transport. Maximum size of built-up area was 1.4km between chainage 41.5km-42.9km though throughout the audit length roadside stores and industrial factories were frequent.

i. School Zones

28 school zones were marked during the survey and the number of students were approximately in between 200-2000 in each school. Although the schools were adjacent to the highway but only 3 of them had speed calming device, warning sign and pedestrian facilities like zebra crossing.

j. Night Visibility

Overall night visibility situation was poor throughout the N3 surveyed section. Sufficient light was required on this survey length particularly on built-up areas. However, lighting was present on sections Ch.+90km-Ch.+92km, Ch.+107km to +Ch.109km but one sided and on adequate condition and in some sections there were poles but no lights (probably stolen or under ongoing project). Other than mentioned before, no formal lighting was found on this road section. The built-up areas, CNG/petrol stations, hotels were found with less adequate lighting system. These built-up areas were observed during survey at day and night, and a combined list has been provided in the ANNEXURE-A that required attention for formal lighting. Signs were not retro-reflective in majority cases. In most cases, signs remained unreadable even from a close distance. During night, road centerline was visible on most of the road length. Road edge lines were visible where given but in some part got faded or shadowed by surroundings. In comparison to other surveyed roads, in this road section night vision was relatively in better condition.

Recommendations for Highway N3

The audit team observed that most of the road corridor has become chaotic due to lack of highway access management, that is why an overall highway access management suggestion is being given in the conclusions section. The major mitigation measures required for highway N3 is given below:

✓ **Immediate measures**

- It will involve restoration of 48.8 km shoulder on both sides of the Highway N3 as per standard design. Also, 27.6 km removal of roadside (both sides) vegetation which reducing shoulder width and obstructing visibility should be removed immediately.
- Fixation of 65 sign posts which have visibility issue and 5 signs to maintain distance from object as per design guideline. As per audit team suggestion, 2161 additional signs should be installed.
- Installation of only 5.2km of pavement markings, improving 16.5km delineation of built-up areas, improvement of pedestrian facilities, installation of bus bays at 4 warranted locations, strengthening enforcement, and safety campaign to local communities.
- 119 roadside hazards/ objects within 2 m of carriageway should be removed immediately.
- A total number of 193 junctions were found on the surveyed length of which 26 had steep slope which needs to be treated immediately. At all junctions, approaching minor road should be aligned at a right angle to major road. Also, the intersections should be fully signed in accordance with the RHD standards.
- Among the 126 bridges/culverts, 123 did not have any provision to walk on footpath which insisting pedestrian to walk through the main carriageway that needed immediate attention as per required design. Count of pedestrian and NMV traffic would be useful in determining the seriousness of this hazard. If the footpath is not feasible, an attempt should be made to encourage vehicles to slow down using signs, markings and warning driver by rumble strips.
- Of the 28 school zones close to the highway, all but 3 require speed management, warning sign and pedestrian facility like zebra crossing/foot over bridge.

Immediate measures should be taken within a year (based on detail investigation comprising of traffic survey, topographic survey and community feedback for pedestrian crossings).

N3

✓ **Midterm measures**

Based on further investigation, It will consist of provision of speed change lane at junctions including channelization where required, provision of truck stands, service roads in built-up areas (following the principles of the highway access management policy), channelization of junctions, provision of right turn lane through widening road sections (where right turning volume is high), pedestrian over bridge and provision of overpass at very congested location to facilitate movement of through traffic. Midterm measures will not be required where RHD has a program to upgrade the road to dual carriageway within next two years.

✓ **Long-term measures**

It will consist of provision of grade separation at important junctions, underpass for pedestrians, flyover at congested part of built-up areas, and separate lane for slow moving vehicles based on further study on the highway. Long term measures are proposed where upgrading to dual carriageway is not up-coming within next five years.

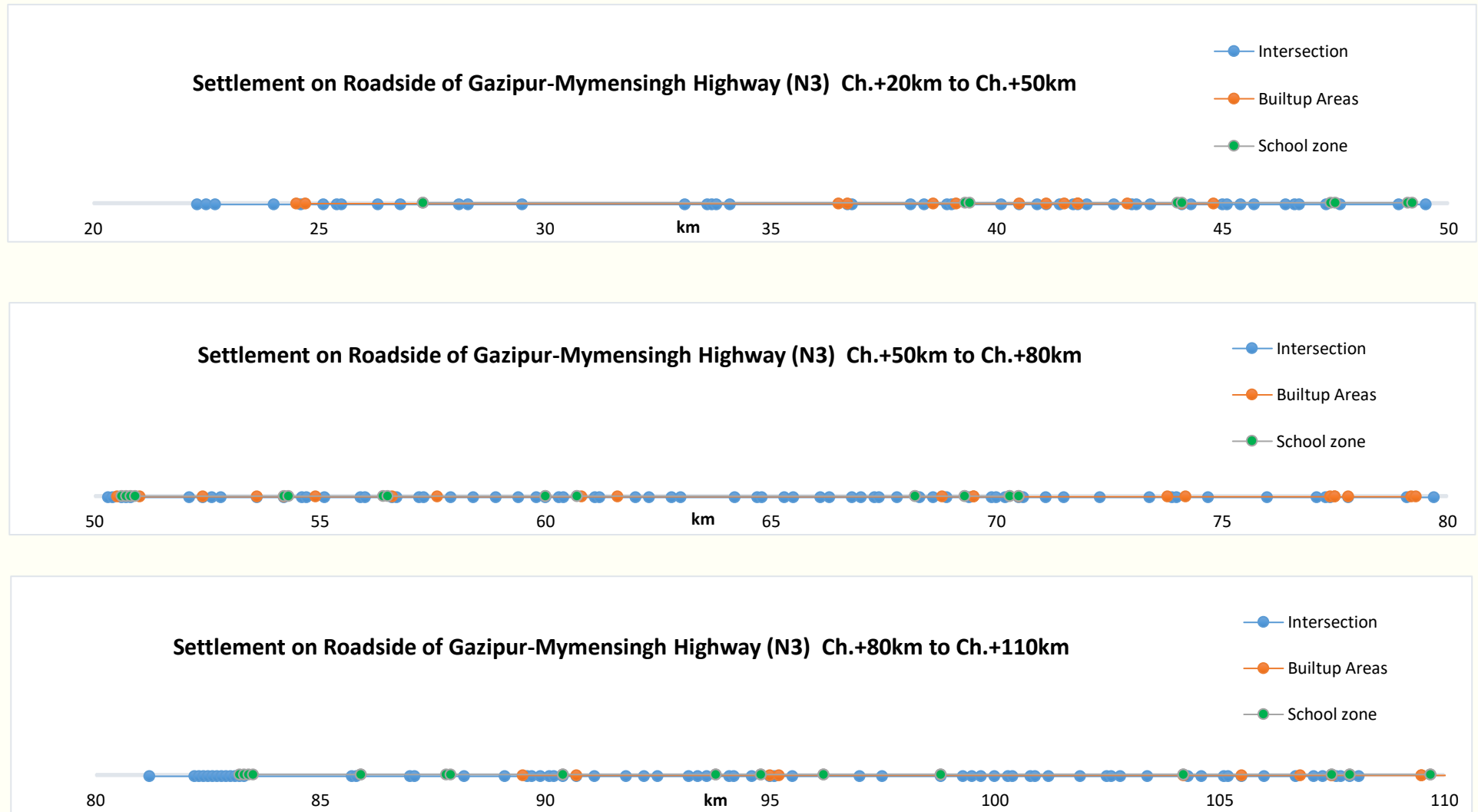


Figure 5.18: Intersections, Built-up Areas and School Zones on Gazipur-Mymensingh Highway (N3)



Faded pedestrian crossing within Ch.+21.8 to Ch.+23.8



Risky km post and unknown sign post in earthen shoulder within Ch.+21.8 to Ch.+23.8



Unauthorized parking within Ch.+21.8 to Ch.+23.8



Disturbed and faded road sign within Ch.+21.8 to Ch.+23.8



Unauthorized vehicle movement within Ch.+23.8 to Ch.+25.8



Illegal parking within Ch.+23.8 to Ch.+25.8



Unauthorized roadside business and non-reflective sign within Ch.+23.8 to Ch.+25.8



Divider without warning sign at Ch.+23.8 to Ch.+25.8



Disturbed road sign and risky shoulder drop within Ch.+23.8 to Ch.+25.8



Unauthorized road side business within Ch.+23.8 to Ch.+25.8



Faded and non-reflective sign within Ch.+25.8 to Ch.+27.8



Faded road sign and marking within Ch.+25.8 to Ch.+27.8



Hazardous km post installed on roadside area within Ch.+25.8 to Ch.+27.8



Faded risky pedestrian crossing within Ch.+27.8 to Ch.+29.8



Poor road marking within Ch.+27.8 to Ch.+29.8



Unauthorized roadside business at Ch.+27.8 to Ch.+29.8



Faded zebra crossing within Ch.+27.8 to Ch.+29.8



Unknown road sign within Ch.+27.8 to Ch.+29.8



Unauthorized roadside occupancy within Ch.+29.8 to Ch.+31.8



Unknown road sign at earthen shoulder at Ch.+31.8 to Ch.+33.8



Risky edge drop and faded road sign within Ch.+35.8 to Ch.+37.8



Faded sign and illegal parking within Ch.+35.8 to Ch.+37.8



Illegal roadside parking within Ch.+35.8 to Ch.+37.8



Invisible road sign within Ch.+37.8 to Ch.+39.8



Faded road sign within Ch.+39.8to Ch.+41.8



Faded road sign within Ch.+43.8 to Ch.+45.8



Disturbed road sign within Ch.+43.8 to Ch.+45.8



Unknown road sign within Ch.+45.8 to Ch.+47.8



**Wrong placement of guard rail within
Ch.+47.8 to Ch.+49.8**



**Illegal roadside activity within
Ch.+49.8 to Ch.+51.6**



**Improper placement of sign within
Ch.+93.5 to Ch.+95.5**



**Roadside bushes & wrong marking on curve
within Ch.+95.5 to Ch.+97.5**



Unauthorized roadside business within Ch.+51.6 to Ch.+53.6



Construction materials kept on roadside area illegally within Ch.+51.6 to Ch.+53.6



Unauthorized parking within Ch.+53.6 to Ch.+55.6



Disturbed & broken sign within Ch.+53.6 to Ch.+55.6



Illegal parking within Ch.+55.6 to Ch.+57.6



Unauthorized occupancy within Ch.+55.6. to Ch.+57.6



Disturbed & broken sign within Ch.+57.6to Ch.+59.6



Illegal pedestrian crossing at Ch.+57.6 to Ch.+59.6



Construction materials kept on roadside area illegally within Ch.+59.6 to Ch.+61.6



Unknown sign within Ch.+59.6 to Ch.+61.6



Contra flow within Ch.+59.6 to Ch.+61.6



Illegal pedestrian movement within Ch.+59.6 to Ch.+61.6



Roadside bushes within Ch.+63.6 to Ch.+65.6



Road construction work along roadside area within Ch.+63.6 to Ch.+65.6 causing high risk



Bus bay occupied by heavy loaded trucks within Ch.+63.6 to Ch.+65.6



Unauthorized parking at Ch.+65.6 to Ch.+67.5



Broken hard shoulder within Ch.+65.6 to Ch.+67.5



Unauthorized occupancy by construction materials within Ch.+67.5 to Ch.+69.5



Disturbed sign post within Ch.+71.5 to Ch.+73.5



Unauthorized occupancy & unknown sign post within Ch.+73.5 to Ch.+75.5



Disturbed sign post within Ch.+75.5 to Ch.+77.5



Disturbed sign post within Ch.+77.5 to Ch.+79.5



Unknown sign within Ch.+77.5 to Ch.+79.5



Faded & invisible sign within Ch.+81.5 to Ch.+83.5



**Faded sign and name plate within
Ch.+81.5 to Ch.+83.5**



**Faded road marking within
Ch.+83.5 to Ch.+85.5**



**Unauthorized occupancy & faded sign within
Ch.+85.5 to Ch.+87.5**



**Faded road marking & unauthorized occupancy
within Ch.+85.5 to Ch.+87.5**



Faded road marking within Ch.+87.5 to Ch.+89.5



Improper placement of sign & unauthorized occupancy within Ch.+89.5 to Ch.+91.5



Construction materials kept on roadside area illegally within Ch.+89.5 to Ch.+91.5



Invisible sign post & insufficient earthen shoulder within Ch.+93.5 to Ch.+95.5



**Crash with electric pole within
Ch.+97.5 to Ch.+99.5**



**No road marking & unauthorized parking
within Ch.+99.5to Ch.+101.5**



Disturbed sign post within Ch.+99.5to Ch.+101.5



**Disturbed & not visible sign post within
Ch.+101.5 to Ch.+103.5**



Unauthorized hazardous roadside structure within Ch+101.5 to Ch+103.5



Roadside bushes & wrong marking on curve within Ch+103.5 to Ch+105.5



Disturbed sign within Ch.+103.5 to Ch.+105.5



Illegal structure & faded road marking at Ch.+105.5 to Ch.+107.5



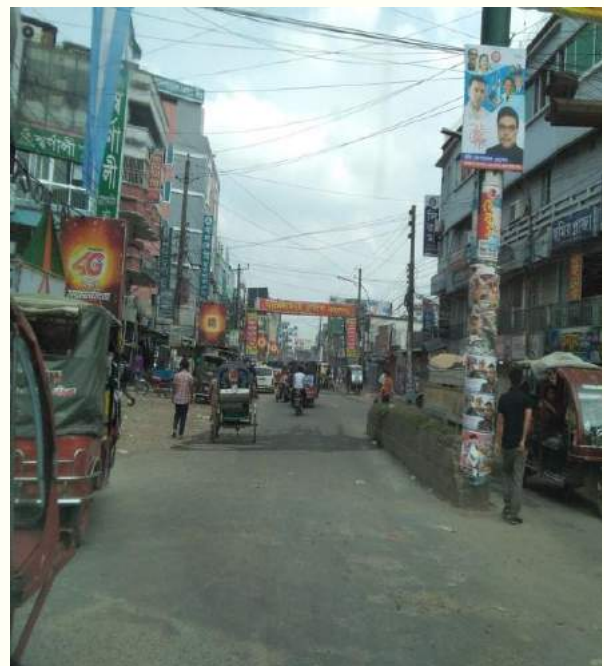
Electric pole on road at Ch.+105.5 to Ch.+107.5



Roadside electric pole & faded road marking within Ch.+107.5 to Ch.+109.5

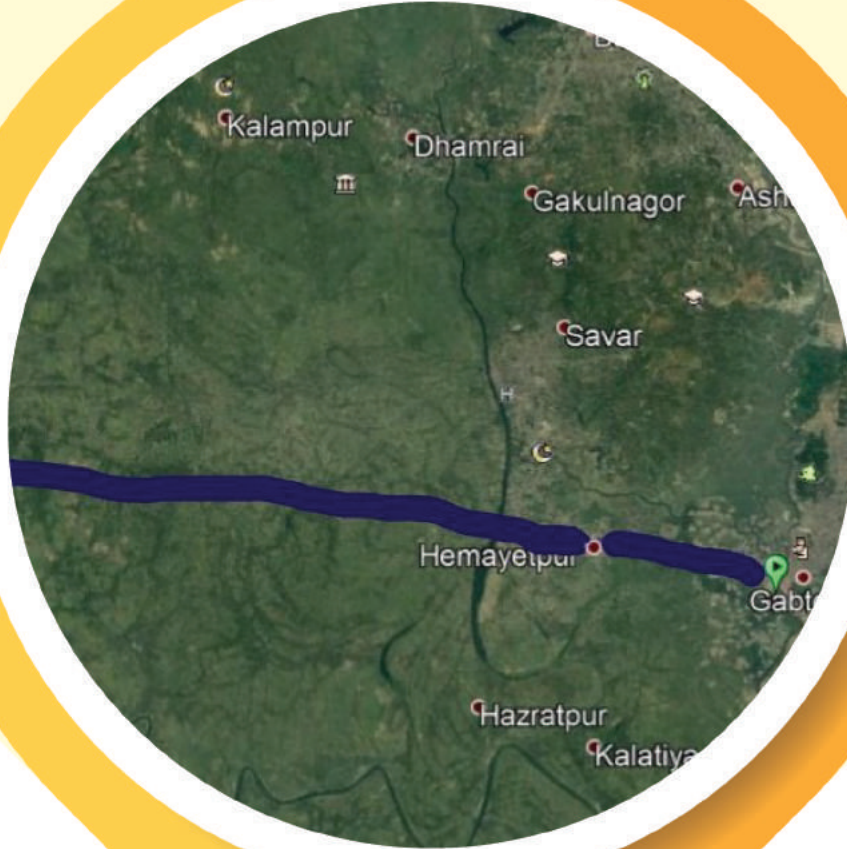


Permanent structure established on roadside area within Ch.+107.5 to Ch.+109.5



Hazardous pole & faded road marking within Ch.+107.5 to Ch.+109.5

SITE DETAILS



N5

DHAKA - ARICHA HIGHWAY
(78.3 KM ON BOTH SIDES OF THE ROAD)

Dhaka - Aricha Highway (N5)

Surveyed length: 78.3 km on both sides of the road

Salient Features of the Study Segment of N5

The Dhaka-Aricha Highway plays a vital role in interregional road transportation in Bangladesh. In the past, this highway was considered as the main artery of transportation in Bangladesh, a man-made death trap owing to the frequent fatal crashes. The Road Safety Audit was conducted from 1 June to 8 June 2018 on this highway road. The road mainly is a 2 lane highway, having 4 lanes in some segments with average width of 7.22m with no NMT line. The road has a standard shoulder of 1.5m and verge/earthen shoulder of 3m.

Road infrastructures details are:

- Major junction: 1 numbers
- Major bridges: 7 numbers
- Minor bridges: 3 numbers
- Culverts: 50 numbers
- Bus lay bays: 11 numbers

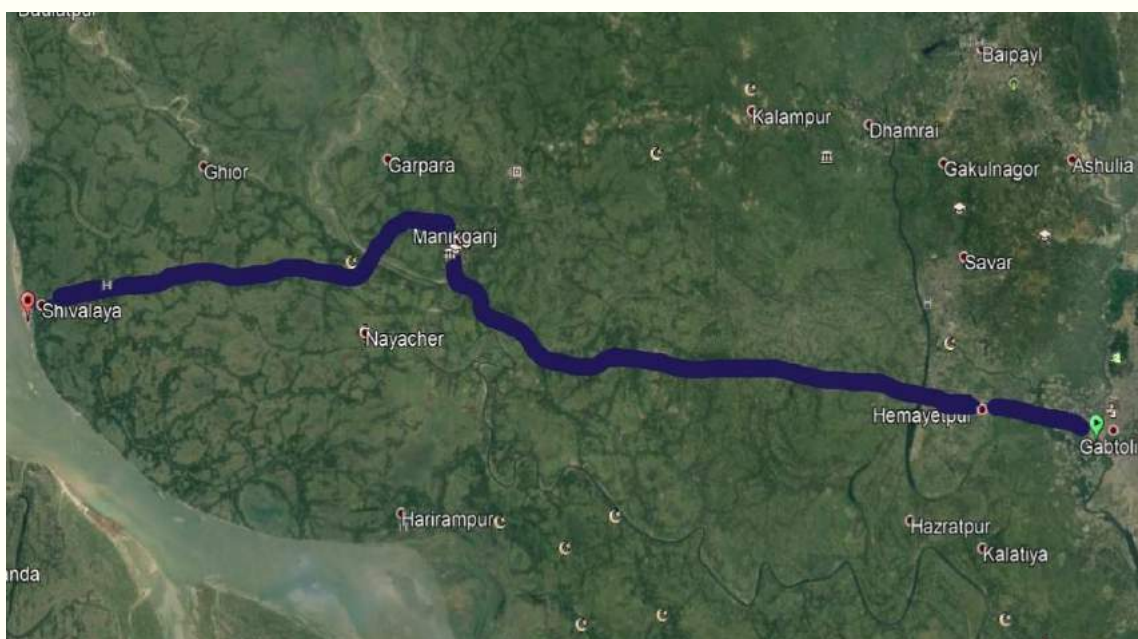


Figure 5.19: Road Section of Dhaka-Aricha Highway (N5) [Source: Google Earth]

Traffic Data

Dhaka - Aricha Highway (N5) is one of the busiest roads in the country and a top development priority. The AADT (Average Annual Daily Traffic) of this road is 18213 (Motorized: 15727, Non-Motorized: 2487). A typical section of the survey area shows the increasing trend of traffic demand.

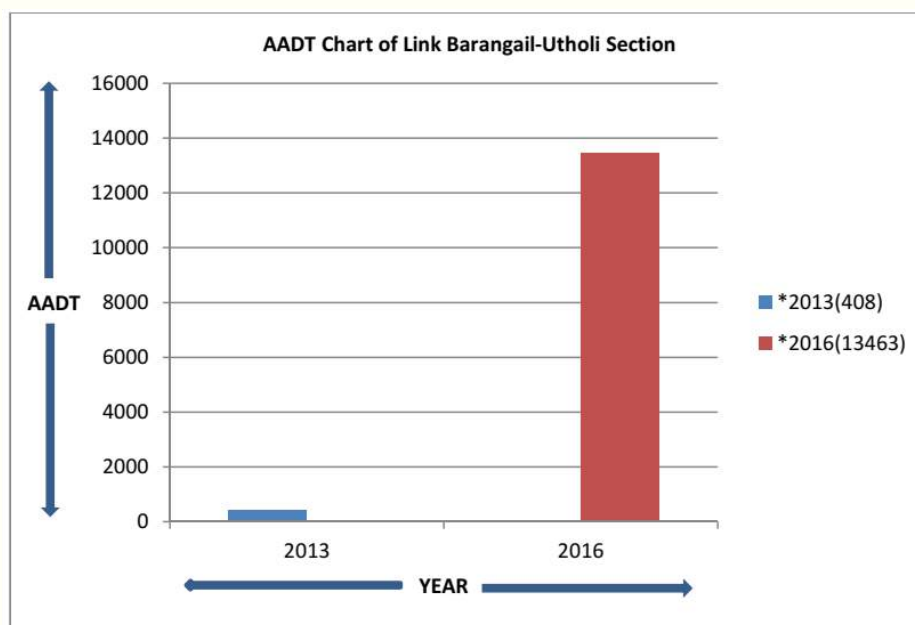


Figure 5.20: AADT Demand Situation on Dhaka - Aricha Highway (N5)
[Source: RMMS (www.rhd.gov.bd/RoadDatabase)]

Road Traffic Injury and Crash Data

Police reported injury and crash statistics (2011-2015) based on statistical analysis shows that since 2011, about 63 crashes were responsible for about 100 fatalities on this highway section. So almost 2 fatalities occurred in each 2km of the surveyed section. The most dominant crash types on this section were hit pedestrians (44%), head on collision (24%), rear end collision (14%) and others consisted the rest 18%. The geometrical feature encourages high speed and lack of enough pedestrian crossings/movement facilities along the dual carriageway highway is the prime reason of high hit pedestrian percentages. The geometrical crash study indicated that 92% crashes took place in the straight sections of the highway compared to only 6% on curves and 2% on crest which referred to the high speed and reckless driving as major concern for treatment of the highway.

Audit Findings

For detailed study and further research regarding N5 highway, check ANNEXURE-C and ANNEXURE-D for specific information.

a. Road Side Hazards

- Roadside hazards are those temporary /permanent structures along the road which may increase crash severity if hit by vehicle. Audit team considered 2m width after the pavement and counted permanent / temporary structures, trees (diameter more than 6cm) and steel poles.
- Roadside clear zone occupied by temporary structures 0.9km (1.1%) on left side during journey from Dhaka to Aricha. From Aricha to Dhaka, temporary structures occupied 0.4 km (0.5%) whereas permanent structures (mainly concrete structures) occupied around 0.5km (.9%) roadside.
- Combining both sides, surveyed road of N5 consisted of 233 trees and 142 poles within 2m from hard shoulder edge.
- Average 1 roadside hazard on every 0.6km and maximum 27 hazards on every 10km were identified on Dhaka-Aricha Highway. Along the Aricha to Dhaka side, average 1 roadside hazard on every 0.3km and maximum 57 hazards on every 10km were identified.

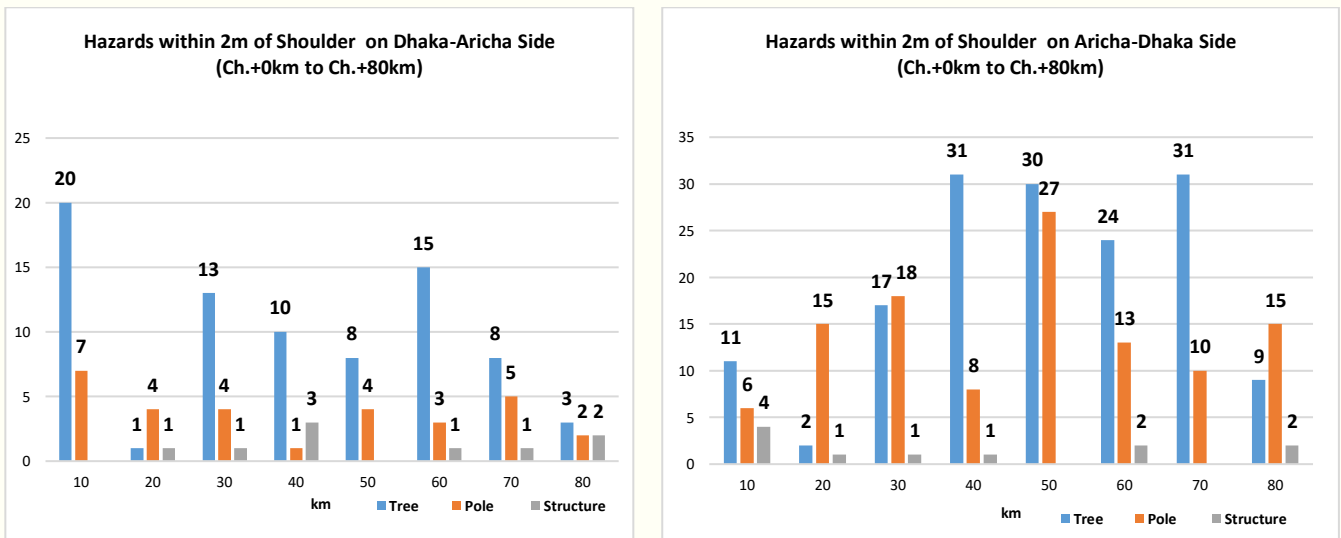


Figure 5.21: Hazards within 2m of Shoulder on Dhaka-Aricha Highway (N5) (Both Sides)

- On Dhaka-Aricha Highway, 19.6 km (25.06%) verge/earthen shoulder was either missing or less than standard dimension of 1m for any emergency traffic movement. 14.7km (18.74%) was found waterlogged, 8km (10.26%) was covered by bushes and 4.7km (6.09%) was occupied by parked vehicles, materials and garbage. A total of 27.1km (34.61%) earthen shoulder was found sufficient (at least 1m width) but 4.11km (5.25%) had highly risky edge drop (more than 3-inch height) which were creating traffic vulnerability.
- On Aricha- Dhaka Highway, 18km (23%) earthen shoulder was either missing or less than standard dimension of 1m for any emergency traffic. 12.5km (16%) was waterlogged, 14.9km (19%) was covered by bushes and 8.6km (11%) was occupied by parked vehicles, materials and garbage. Out of total 78.3km earthen shoulder, 17.2km (22%) was sufficient.
- Immediate measure required chainages of roadside hazards are given in ANNEXURE-A.

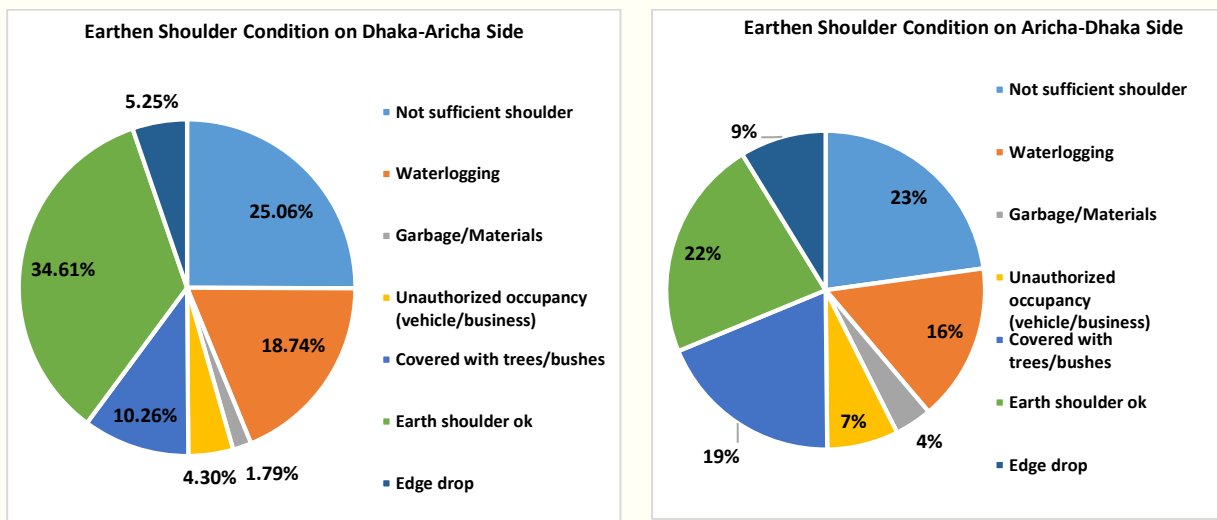


Figure 5.22: Earthen Shoulder Condition on Dhaka-Aricha Highway (N5) (Both Sides)

b. Signs

- Necessary regulatory, warning and information signs were not in place. Existing signs were not workable and clear. In some cases, no regulatory, warning or information signs were placed. Sometimes non-conventional signs were placed at the center of carriageway without any engineered treatment

- A total number of 218 signs were found in both sides of the highway, which were mainly A26, A33, B3, B31, B13 etc.
- Some of the existing signs were not visible due to roadside activities such as roadside shops, billboards on street parking, temporary gate installed on the road etc. Some signs were not at all visible due to vegetation and some were not visible from a distance due to vegetation. Some signs were ineffective and illegible due to faded color in the background, letters, signs and borders. Team observed 14 signs (N.B: ANNEXURE-A) having such problems.
- According to BRTA manual, for an 80km speed highway, the sign should be placed 150m far from object, which did not meet, in most of the cases along the road length. Team found a total of 4 signs (N.B: ANNEXURE-A) which were very close to the hazard and very hard to understand by moving traffic.
- Audit team suggested to put additional 1509 signs along the highway which were required but missing and mandatory to make the road safer which were mainly A1, B31, B10, B3, C2 etc. A list of additionally required signs suggested by audit team and immediate sign required locations has been given in the ANNEXURE-A.
- The team observed a total number of 1527 signs needed to be prepared/ installed.

c. Pavement Stature

- From Dhaka to Aricha Highway, 73.6km (94.1%) of the pavement of the surveyed 78.3km was workable. 4km (5.1%) was distressed, 0.6 km (0.8%) had waterlogging (N.B: ANNEXURE-A) which were creating serious vulnerability.

N5

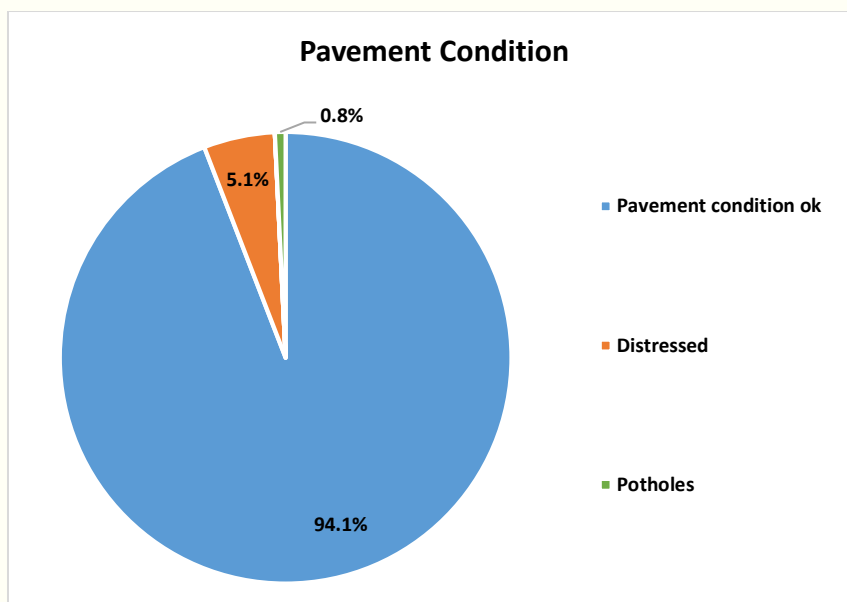


Figure 5.23: Pavement Condition on Dhaka-Aricha Highway (N5)

- The roadway had 3km sharp curve region which were very risky as delineation in all section was very poor.
- Almost 13km on left side of Dhaka-Aricha Highway had inadequate hard shoulder width (less than 1.5m) which did not meet RHD standard though 65.3km shoulder was properly maintained. On the right side of Dhaka-Aricha Highway, 12km had inadequate hard shoulder and rest section was found appropriate as per design standard.
- Road marking was found on only 62.4km of the total surveyed length with most length having faded centerline and partially faded edge line.
- Speed bumps were found on 32 locations of the survey length which did not meet the standard of RHD design guideline (for 50 kmph, length should be 9.5 m and height 10cm). Those should be treated immediately. 5 of them had advanced warning signs whereas all of them should have advanced warning signs.
- Median was found in 27.5km of the total survey length whereas 27km had standard width and height, 20.1km bushes and 2km illegal structures on them and 21.1 km had adequate painting. In no point U-turn sign was provided.

d. Parking Facilities

Survey team explored 156 locations where road was being occupied by illegal road side parking which indicated the necessity of formal parking facility along the road way. No formal parking was found.

e. Bus Bay

The surveyed length had 11 bus bays. Most of their width was not adequate according to the guideline (N.B: ANNEXURE-A). Minimum width of the bus bay should be 3.7m in addition to main carriageway. There was advanced sign on 1 of the bus bay but 1 bus bay had extra lane and 1 had acceleration/deceleration lane (Ch.+12.1km). The survey team suggested bus bays in 8 new locations (N.B: ANNEXURE-A) for better road capacity and traffic safety.

f. Bridges/Culverts

The survey team found 18 culverts, 50 small span bridges (less than 100m length), 3 medium size (length in between 100m and 500m) bridges and 7 large bridges (length more than 500m). Among those bridge/culverts, 11 did not have any provision to walk on footpath which insisting pedestrian to walk through the main carriageway which needed immediate attention. 69 of all the structures had working guard rail/post whereas 9 had disturbed due to previous collision with it or construction decay. Reflector was not available in 9 and only 67 of them had proper pedestrian facilities. Practice of hazard sign was not found on any of the bridges/culverts.

g. Intersections

A total number of 115 intersections were found on the surveyed length where 4 were channelized, 111 were un-channelized. Among the intersections, 109 were at right angle, 6 were on 45 degree angle or Y-junction. Among the junctions, 26 had steep slope which needed to be treated immediately. Corner radius was not provided in 94 of them and 1 had speed change lanes. Among the surveyed intersections, there was warning sign in only 17 intersections. Out of all intersections, 14 intersections were not clearly visible from the main road which might cause crashes. Only 2 intersections had pedestrian facility.

h. Built-up Areas

The team addressed roadside business areas which were unauthorized as most of them were situated very close to the road. According to the law, there should not be any business activity within 10m of the roadside area. Among the surveyed length, 16km was marked as built-up area in 19 locations (N.B: ANNEXURE-A), and none of them had welcome sign or speed limit sign or speed calming devices. No areas had adequate pedestrian facilities. The dominating structure in these areas was concrete structure. Vehicle types in these areas were mixed though bus was the rapidly used mode of transport. Maximum size of built-up area was about 4km between chainage 10km-14km and throughout the audit length, roadside stores and industrial factories were frequent.

i. School Zones

6 school zones were marked during the survey and the number of students were approximately in between 200-600 in each school. Jahangirnagar University (Ch.+16km to Ch.+18km) had about 12000 students and this section was the most vulnerable for pedestrians. Though the schools were adjacent to the highway but only 1 of them had speed calming device, warning sign and pedestrian facilities like zebra crossing was available(Ch.+16.2km).

j. Night Visibility

Overall night visibility was poor throughout the N5 surveyed section. Sufficient lighting was required on this survey length particularly on built-up areas. However, lighting was present on sections in very low count and in most sections there were pole but no light (probably stolen or under ongoing project). Ch.+20 to Ch.+30 section had poor lighting and this busy section required immediate attention. Overall, there was no formal lighting found on this road section. The built-up areas, CNG/petrol stations, hotels had private lighting system. These built-up areas were closely observed and a combined list was provided in the ANNEXURE-A and required attention for formal lighting. Signs were not retro-reflective. Most signs had low visibility. In most cases, signs remained unreadable even from a close distance. During night, road centerline was visible but faded parts on most of the road length rendered it useless. Road edge lines were visible where given but in some part got faded or shadowed by surroundings.

Recommendations for Highway N5

The audit team observed that most of the road corridor has become chaotic due to lack of highway access management, that is why an overall highway access management suggestion is being given in the conclusions section. The major mitigation measures required for highway N5 is given below:

✓ Immediate measures

- It will involve restoration of 13 km shoulder on both sides of the Highway N5 as per standard design. Also, 22.9 km removal of roadside (both sides) vegetation which reducing shoulder width and obstructing visibility should be removed immediately. 11.15 km of high drop-offs at shoulders should be removed all along the highway
- Fixation of 14 sign posts which have visibility issue and 4 signs to maintain distance from object as per design guideline. As per audit team suggestion, 1509 additional signs should be installed.
- Installation of 15.6 km of pavement markings, improving 16 km delineation of built-up areas, improvement of pedestrian facilities, installation of bus bays at 8 warranted locations, strengthening enforcement, and safety campaign to local communities.
- Detail engineering studies are suggested to establish/enforce appropriate special speed limits/speed zoning for the Built-up Areas/Bazaars.
- 375 roadside hazards/ objects within 2 m of carriageway should be removed immediately.
- A total number of 115 junctions were found on the surveyed length of which 26 had steep slope which needs to be treated immediately. At all junctions, approaching minor road should be aligned at a right angle to major road. Also, the intersections should be fully signed in accordance with the RHD standards.
- Among the 71 bridges/culverts, 60 did not have any provision to walk on footpath which insisting pedestrian to walk through the main carriageway that needed immediate attention as per required design. Count of pedestrian and NMV traffic would be useful in determining the seriousness of this hazard. If the footpath is not feasible, an attempt should be made to encourage vehicles to slow down using signs, markings and warning driver by rumble strips.

- Of the 6 school zones close to the highway, all but 1 require speed management, warning sign and pedestrian facility like zebra crossing/foot over bridge.

Immediate measures should be taken within a year (based on detail investigation comprising of traffic survey, topographic survey and community feedback for pedestrian crossings).

✓ **Midterm measures**

Based on further investigation, It will consist of provision of speed change lane at junctions including channelization where required, provision of truck stands, service roads in built-up areas (following the principles of the highway access management policy), channelization of junctions, provision of right turn lane through widening road sections (where right turning volume is high), pedestrian over bridge and provision of overpass at very congested location to facilitate movement of through traffic. Midterm measures will not be required where RHD has a program to upgrade the road to dual carriageway within next two years.

✓ **Long-term measures**

It will consist of provision of grade separation at important junctions, underpass for pedestrians, flyover at congested part of built-up areas, and separate lane for slow moving vehicles based on further study on the highway. Long term measures are proposed where upgrading to dual carriageway is not up-coming within next five years.

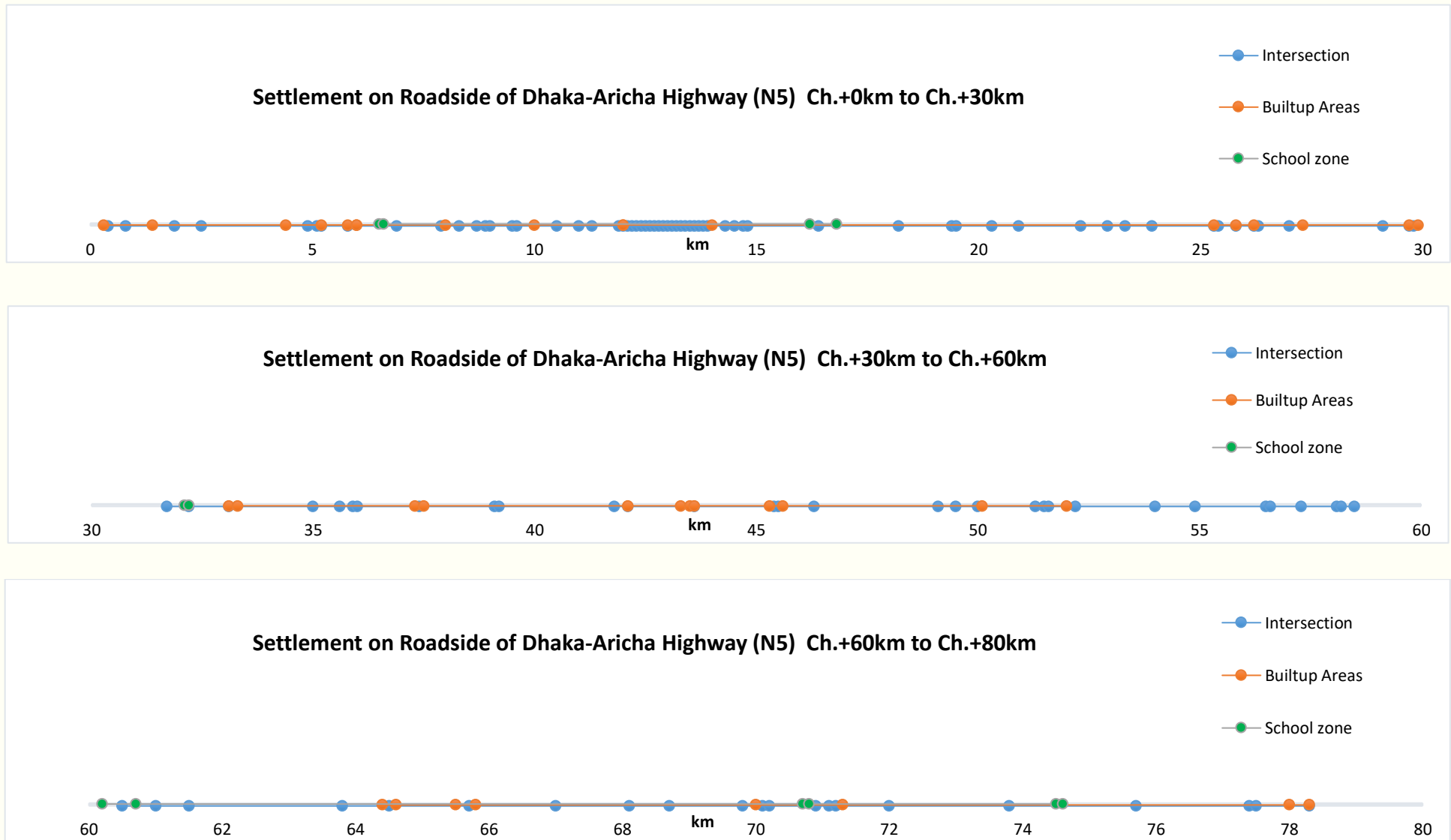


Figure 5.24: Intersections, Built-up Areas and School Zones on Dhaka-Aricha Highway (N5)



No pedestrian crossing facility on the bridge at Ch.+0 to Ch.+2



Earthen shoulder within Ch.+2 to Ch.+4 is at risk due to roadside tree



Unauthorized roadside parking within Ch.+4 to Ch.+6



Risky shoulder within Ch.+12 to Ch.+14



Water logging within Ch.+14 to Ch.+16



Unauthorized roadside business within Ch.+24 to Ch.+26



Disturbed road sign within Ch.+26 to Ch.+28 is misplaced and less visible



Earthen shoulder within Ch.+26 to Ch.+28 gets blocked by roadside large tree



Risky concrete pole in earthen shoulder within Ch.+26 to Ch.+28



Road Sign in earthen shoulder within Ch.+28 to Ch.+30



Absence of warning sign at median within Ch.+28 to Ch.+30



Risky edge drop within Ch.+30 to Ch.+32



Unknown km post at earthen shoulder within Ch.+32 to Ch.+34



Sign post on earthen shoulder within Ch.+34 to Ch.+36 causing risk



Disturbed, unknown km post within Ch.+36 to Ch.+38



Disturbed road sign within Ch.+38 to Ch.+40



Unknown km post in earthen shoulder within Ch.+40 to Ch.+42



Risky structure at earthen shoulder within Ch.+42 to Ch.+44



Risky concrete block placed within Ch.+42 to Ch.+44



Defective roadside area within Ch.+42 to Ch.+44



Disturbed road sign within Ch.+42 to Ch.+44



Unauthorized roadside business within Ch.+44 to Ch.+46



Risky shoulder drop within Ch.+46 to Ch.+48



Risky, unknown road sign within Ch.+48 to Ch.+50



Unauthorized roadside business within Ch.+48 to Ch.+50



Risky sign post on shoulder within Ch.+48 to Ch.+50



Less visible road sign within Ch.+58 to Ch.+60



Faded and unknown road sign within Ch.+58 to Ch.+60



Less visible road sign within Ch.+60 to Ch.+62



Disturbed road sign within Ch.+62 to Ch.+64



Less visible road sign within Ch.+64 to Ch.+66



Disturbed warning sign within Ch.+66 to Ch.+68



Faded road sign within Ch.+68 to Ch.+70



Unknown road sign at shoulder within Ch.+74 to Ch.+76



Illegal roadside parking at Ch.+78

SITE DETAILS



N1

KANCHPUR – DAUDKANDI HIGHWAY
(31.5 KM ON BOTH SIDES OF THE ROAD)

N1

Kanchpur – Daudkandi Highway (N1)

Surveyed length: 31.5 km on both sides of the road

Salient Features of the Study Segment of N1

The N1 or Kanchpur–Daudkandi Highway is one of the main transportation arteries in Bangladesh, between Dhaka and Chattogram. The road safety audit was conducted from 9 June to 11 June 2018 on this highway road. This N1 route connects Kanchpur bridge, Meghna bridge and Gumti 2nd bridge. Gumti 2nd bridge is now under construction to support increasing traffic volume on Dhaka - Chattogram National Highway as N1 is one of the busiest roads in the country and a top development priority. The road mainly is a 4 lane highway with average width of 8.35m with no NMT line. The road has a standard shoulder of 1.5m and verge/earthen shoulder of 1m.

Road infrastructures details are:

- Major junctions: 3 numbers
- Major bridges: 2 numbers
- Minor bridges: 4 numbers
- Culverts: 17 numbers
- Bus lay bays: 5 numbers

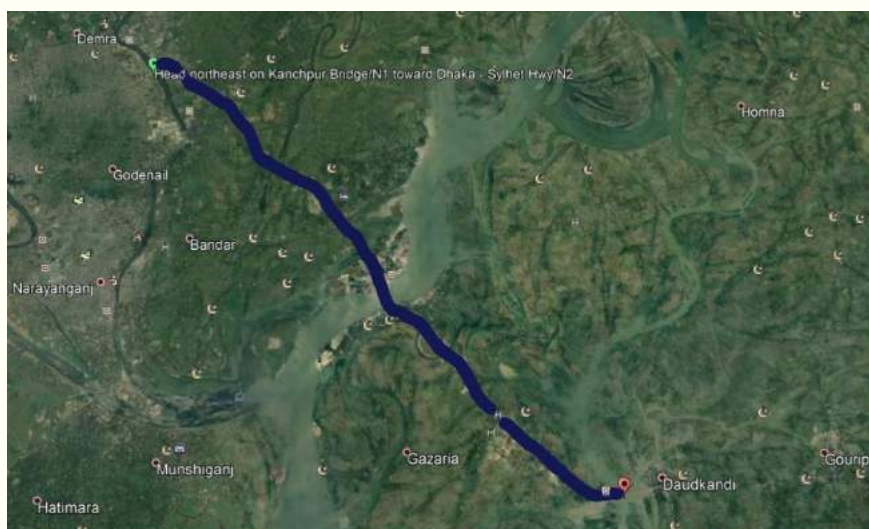


Figure 5.25: Road Section of Kanchpur – Daudkandi Highway (N1) [Source: Google Earth]

Traffic Data

N1 is one of the busiest roads in the country and a top development priority. The AADT (Average Annual Daily Traffic) of this road is 23272 (Motorized: 21961, Non-Motorized: 1312). A typical section of the survey area shows increasing trend of traffic demand.

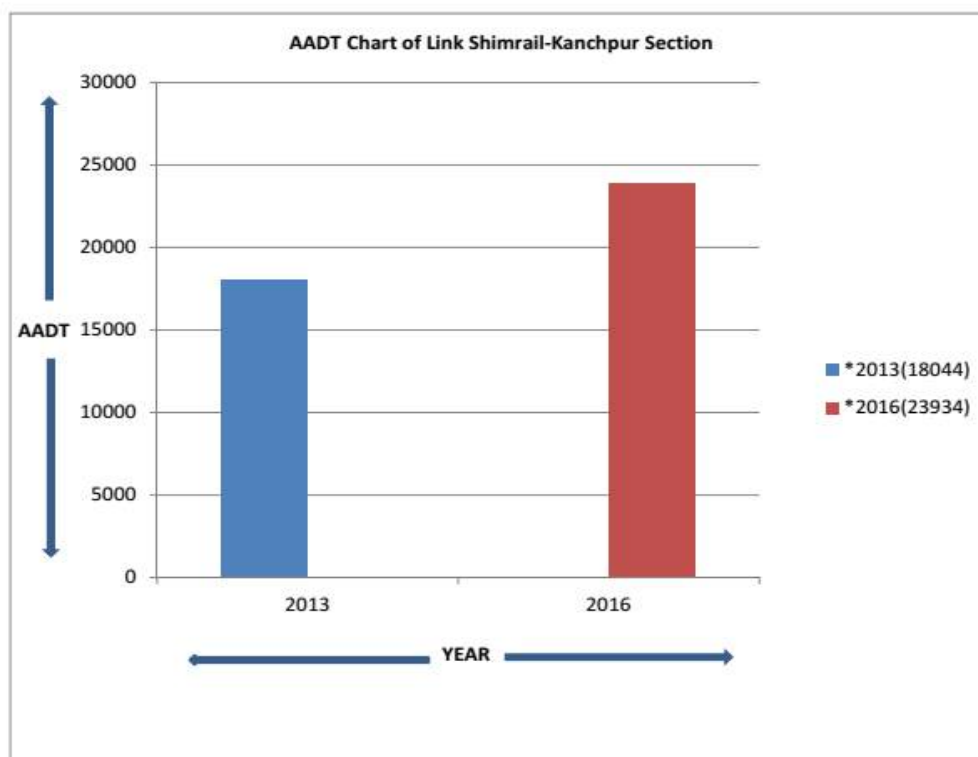
N1


Figure 5.26: AADT Demand Situation on Kanchpur-Daudkandi Highway (N1)
[Source: RMMS (www.rhd.gov.bd/RoadDatabase)]

Road Traffic Injury and Crash Data

Police reported injury and crash statistics (2011-2015) based on statistical analysis shows that since 2011, about 21 crashes were responsible for about 25 fatalities on this highway section 32 km. So almost 2 fatalities occurred in each 2km of the surveyed section. The most dominant crash types on this section were hit pedestrians (48%), head on collision (24%), others consisted the rest 30%. The geometrical feature encourages high speed and lack of enough pedestrian crossings/movement facilities along the dual carriageway highway is the prime reason of high hit pedestrian percentages. The geometrical crash study indicates that 86% crashes took place in the straight sections of the highway compared to only 10% on curves and 5% on slope which referred to the high speed and reckless driving as major concern for treatment of the highway.

Audit Findings

For detailed study and further research regarding N1 (Kanchpur) highway, check ANNEXURE-C and ANNEXURE-D for specific information.

N1

a. Road Side Hazards

- Roadside hazards are those temporary /permanent structures along the road which might increase crash severity if hit by vehicle. Audit team considered 2m width after the pavement and counted permanent / temporary structures, trees (diameter more than 6cm) and steel poles.
- There was no temporary/permanent structure on left side during journey from Kanchpur to Daudkandi. On Daudkandi to Kanchpur, temporary structures occupied 1.4km (4.4%).
- Combining both sides, surveyed road of N1 consisted of 1 tree and 12nos poles within 2m from hard shoulder edge.
- Average 1 roadside hazard on every 0.1km and maximum 2 hazards on every 10km were identified on Kanchpur to Daudkandi Highway. Along the Daudkandi to Kanchpur side, average 1 roadside hazard on every 0.75km and maximum 16 hazards on every 10km were identified. Maximum roadside hazards were at the built-up area of Daudkandi city area.

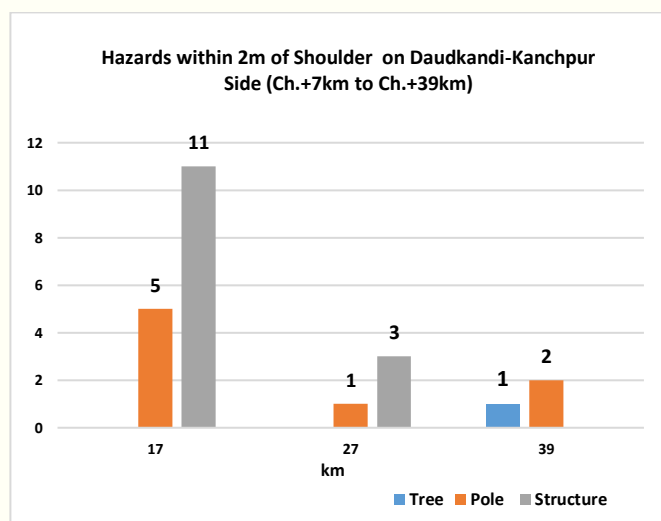
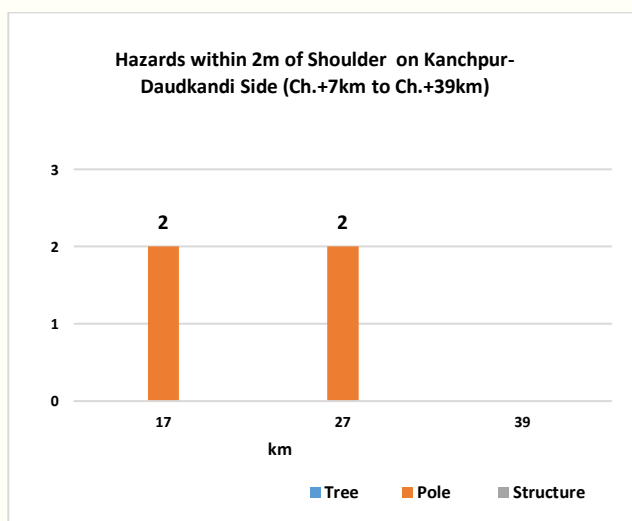


Figure 5.27: Hazards within 2m of Shoulder on Kanchpur-Daudkandi Highway (N1)
(Both Sides)

- On Kanchpur-Daudkandi Highway, 2.7 km (8.4%) earthen shoulder was either missing or less than standard dimension of 1m for any emergency traffic movement. 6.1km (19.1%) was found waterlogged, 0.9km (2.8%) was covered by bushes and 3km (9.3%) was occupied by parked vehicles, materials and garbage. A total of 19km (59.4%) earthen shoulder was found sufficient (at least 1m width) but 0.03km (0.9%) had highly risky edge drop (more than 3-inch height) which were creating traffic vulnerability.
- On Daudkandi-Kanchpur highway, 2.8km (8.8%) earthen shoulder was either missing or less than standard dimension of 1m for any emergency traffic, 7.1km (22.82%) was waterlogged, 4.3km (13.82%) was covered by bushes and 2.3km (7.4%) was occupied by parked vehicles, materials and garbage. Out of total 31.1km earthen shoulder, 16.8km (52.5%) was sufficient.
- Immediate measure required chainages of roadside hazards are given in ANNEXURE-A.

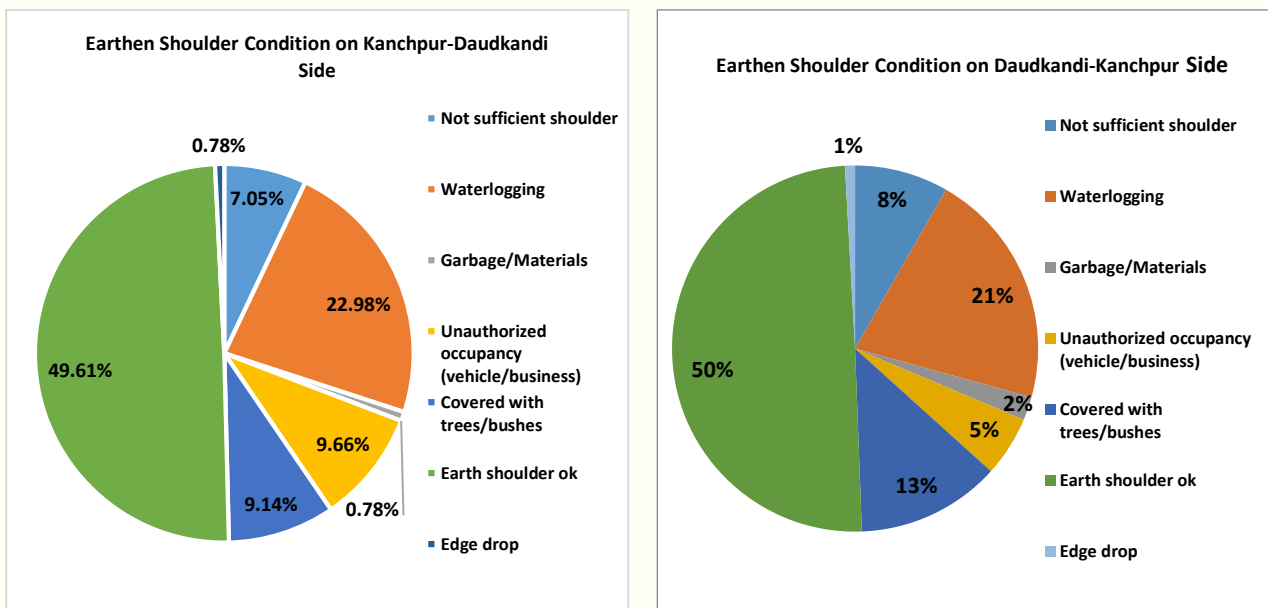


Figure 5.28: Earthen Shoulder Condition on Kanchpur-Daudkandi Highway (N1) (Both Side)

b. Signs

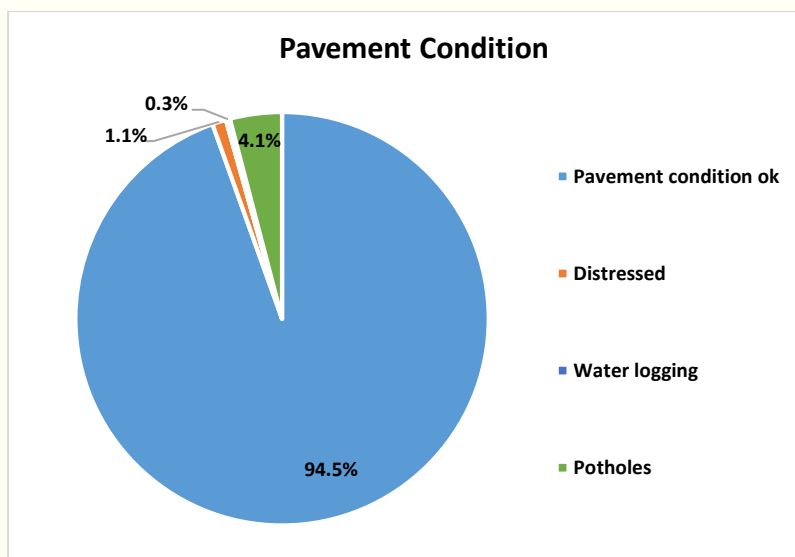
- Necessary regulatory, warning and information signs were not in place. Existing signs were not quite workable and clear. In some cases, no regulatory, warning or information signs were placed. Sometimes non-

conventional signs were placed at the center of carriageway without any engineered treatment

- A total number of 61 signs were found in both sides of the highway, which were mainly A20, A26, B10, B36, B38, B13 etc.
- Some of the existing signs were not visible due to roadside activities, such as, roadside shops, billboards on street parking, temporary gate installed on the road etc. Some signs were not at all visible due to vegetation and some were not visible from a distance due to vegetation. Some signs were ineffective and illegible due to faded color in the background, letters, signs and borders. Team observed 2 signs (N.B: ANNEXURE-A) having such problems.
- According to BRTA manual, for an 80km speed highway, the sign should be placed 150m far from object which did not meet in most of the cases along the road length. Team found a total of 2 signs (N.B: ANNEXURE-A) which were very close to the hazard and very hard to understand by moving traffic.
- Audit team suggested to put additional 470 signs along the highway which were required but missing and mandatory to make the road safer which were mainly A1, B31, B10, B3, C2 etc. A list of additionally required signs suggested by audit team and immediate sign required locations has been given in the ANNEXURE-A.
- The team observed a total number of 474 signs needed to be prepared/ installed.

c. Pavement Stature

- From Kanchpur to Daudkandi Highway, 30.4km (97.8%) of the pavement of 31.1km was workable whereas 0.1km (0.3%) was distressed, 0.2 km (0.6%) pavement had waterlogging (N.B: ANNEXURE-A), 0.4km (1.3%) pavement had potholes (N.B: ANNEXURE-A), which were creating serious vulnerability.



N1

Figure 5.29: Pavement Condition on Kanchpur-Daudkandi Highway (N1)

- The roadway had 1.4km sharp curve region which were very risky as delineation in all section was very poor.
- Almost 7.3km on left side of Kanchpur-Daudkandi Highway had inadequate hard shoulder width (less than 1.5m) which did not meet RHD standard though 23.8km shoulder was properly maintained. On the right side of Kanchpur-Daudkandi Highway, 10.8km had inadequate hard shoulder and rest section was found appropriate as per design standard.
- Road marking was found on 30km (93.75%) of the total survey length. Though most of the road length covered road markings, but the condition was poor as most of them had faded marking on both centerline and edge.
- Speed bumps were found on 5 locations of the survey length which did not meet the standard of RHD design guideline (for 50 kmph, length should be 9.5 m and height 10cm). Those should be treated immediately. 2 of them had advanced warning sign whereas all of them should have advanced warning sign.
- Median was found in 28.9km of the total survey length whereas 24.8km had standard width and height, 21.8km had bush on the median and 4.6 km had adequate painting. In 1-point U-turn sign and in all points reflectors were provided.

d. Parking Facilities

Survey team explored 21 locations where road was being occupied by illegal roadside parking which indicated the necessity of formal parking facility along the roadway.

e. Bus Bay

The surveyed length had 5 bus bays. Most of their width was not adequate according to the guideline (N.B: ANNEXURE-A). Minimum width of the bus bay should be 3.7m in addition to main carriageway. There was neither any advanced sign on these bus bays nor any extra lane but 2 had acceleration/deceleration lane. The survey team suggested bus bays in 7 new locations (N.B: ANNEXURE-A) for better road capacity and traffic safety.

f. Bridges/Culverts

The survey team observed 17 culverts, 4 small span bridges (less than 100m length), 4 medium size (length in between 100m and 500m) bridge, and 2 large bridges (length more than 500m). Among those bridges/culverts, 16 did not have any provision to walk on footpath which insisted pedestrian to walk through the main carriageway that needed immediate attention. 18 of all the structures had working guard rail/post. Reflector was not available in 23. Practice of hazard sign was not found on any of the bridges/culverts.

g. Intersections

A total number of 36 intersections were found on the surveyed length where all 36 were un-channelized. Among the intersections, 35 were at right angle, 1 was 45 degree angle or Y-junction. Among the junctions, 13 had steep slope which needed to be treated immediately. Corner radius was not provided in 12 of them and none had speed change lanes. Among the surveyed intersections, there was warning sign in only 4 intersections. Out of all intersections, 9 were not clearly visible from the main road which might cause crashes. Only 4 intersections had pedestrian facilities.

h. Built-up Areas

The team addressed roadside business areas which were unauthorized as most of them were situated very close to the road. According to the law, there should not be any business activity within 10m of the roadside area. Among the surveyed length, 4.3km was marked as built-up area in 6 locations (N.B: ANNEXURE-A) and none of

them had welcome sign or speed limit sign or speed calming devices. No areas had pedestrian facilities. The dominating structure in these areas was concrete structure. Vehicle types in these areas were mixed though bus was the rapidly used mode of transport. Maximum size of built-up area was 2km between chainage 7-9km.

i. School Zones

3 school zones were marked during the survey and the number of students was approximately in between 400-1000 in each school. Though the schools were adjacent to the highway but none of them had speed calming device, warning sign and pedestrian facilities like zebra crossing.

j. Night Visibility

Overall night visibility situation was poor throughout the N1(Kanchpur-Daudkandi) survey section. Light was required on this survey length particularly on built-up areas. However, lighting was present on toll plaza and ongoing construction sections (between Ch.+7km-Ch.+17km & Ch.+37km-Ch.+39km). On some sections there was pole but no light (probably stolen or under ongoing project). Ch.+7 to Ch+37 section had poor lighting condition and this busy road section required immediate attention. Overall, there was no formal lighting found on this road section. The built-up areas, CNG/petrol stations, hotels had their own lighting. These built-up areas were closely surveyed at day and night time and a combined list was provided in the ANNEXURE-A and required attention for formal lighting. Signs were not retro-reflective in most cases; signs remained unreadable even from a close distance. During night, road centerline was visible but got faded on most of the roadway length which rendered it useless. Road edge lines were visible where given but in some got faded or shadowed by surroundings.

Recommendations for Highway N1 (Kanchpur- Daudkandi)

The audit team observed that most of the road corridor has become chaotic due to lack of highway access management, that is why an overall highway access management suggestion in being given in the conclusions section. The major mitigation measures required for highway N1 (Kanchpur) is given below:

✓ Immediate measures

- It will involve restoration of 18.1 km shoulder on both sides of the Highway N1 as per standard design. Also, 5.2 km removal of roadside (both sides)

vegetation which reducing shoulder width and obstructing visibility should be removed immediately.

- Fixation of 2 sign posts which have visibility issue and 2 signs to maintain distance from object as per design guideline. As per audit team suggestion, 470 additional signs should be installed.
- Installation of 1.5 km of pavement markings, improving 4.3km delineation of built-up areas, improvement of pedestrian facilities, installation of bus bays at 7 warranted locations, strengthening enforcement, and safety campaign to local communities.
- Detail engineering studies are suggested to establish/enforce appropriate special speed limits/speed zoning for the Built-up Areas/Bazaars.
- 13 roadside hazards/ objects within 2 m of carriageway should be removed immediately.
- A total number of 36 junctions were found on the surveyed length of which 13 had steep slope which needs to be treated immediately. At all junctions, approaching minor road should be aligned at a right angel to major road. Also, the intersections should be fully signed in accordance with the RHD standards.
- Among the 25 bridges/culverts, 16 did not have any provision to walk on footpath which insisting pedestrian to walk through the main carriageway that needed immediate attention as per required design. Count of pedestrian and NMV traffic would be useful in determining the seriousness of this hazard. If the footpath is not feasible, an attempt should be made to encourage vehicles to slow down using signs, markings and warning driver by rumble strips.
- Of the 3 school zones close to the highway, all require speed management, warning sign and pedestrian facility like zebra crossing/foot over bridge.

Immediate measures should be taken within a year (based on detail investigation comprising of traffic survey, topographic survey and community feedback for pedestrian crossings).

✓ **Midterm measures**

Based on further investigation, It will consist of provision of speed change lane at junctions including channelization where required, provision of truck

stands, service roads in built-up areas (following the principles of the highway access management policy), channelization of junctions, provision of right turn lane through widening road sections (where right turning volume is high), pedestrian over bridge and provision of overpass at very congested location to facilitate movement of through traffic. Midterm measures will not be required where RHD has a program to upgrade the road to dual carriageway within next two years.

✓ **Long-term measures**

It will consist of provision of grade separation at important junctions, underpass for pedestrians, flyover at congested part of built-up areas, and separate lane for slow moving vehicles based on further study on the highway. Long term measures are proposed where upgrading to dual carriageway is not up-coming within next five years.

N1

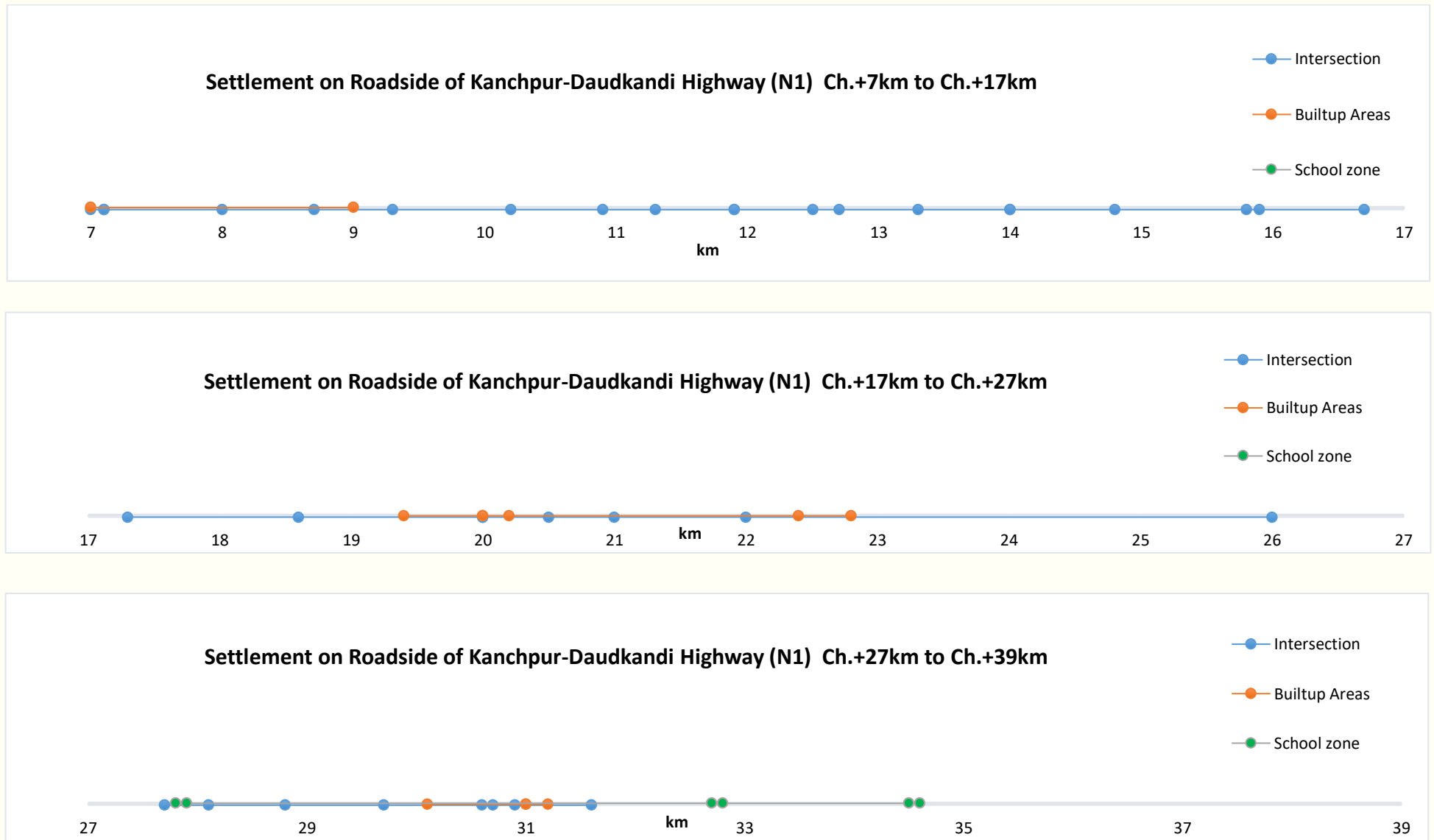


Figure 5.30: Intersections, Built-up Areas and School Zones on Kanchpur-Daudkandi Highway (N1)



Unauthorized roadside activity within Ch.+ 7 to Ch.+9



Blocks causing risk for pedestrian movement within Ch.+7 to Ch.+9



Improper bridge facilities within Ch.+7 to Ch.+9



Risky and broken blocks on middle road Ch.+ 9 to Ch.+11



Unauthorized roadside activities within Ch.+13 to Ch.+15



Disturbed sign within Ch.+15 to Ch.+17



Invisible roadside posts Ch.+ 15 to Ch.+17



Poor and broken median within Ch.+15 to Ch.+17



Disturbed sign within Ch.+17 to Ch.+19



Illegal and risky road crossing activity within Ch.+ 19 to Ch.+21



Broken shoulder and waterlogging within Ch.+19 to Ch.+21



km post within clear zone at Ch.+21 to Ch.+23



Wrongly designed sign within Ch.+23 to Ch.+25



Hazardous median blocks within Ch.+23 to Ch.+25



Hazardous concrete block within Ch.+23 to Ch.+25



Waterlogged roadside within Ch.+25 to Ch.+27



Pedestrian standing on busy road within Ch.+ 25 to Ch.+27



Wrongly designed sign within Ch.+25 to Ch.+27



Wrongly designed road sign within Ch.+27 to Ch.+29



Pedestrians walking on road within Ch.+27 to Ch.+29



Risky drop and poor sign visibility within Ch.+ 9 to Ch.+11



Poor and risky shoulder drop within Ch.+11 to Ch.+13



Median without proper protection within Ch.+11 to Ch.+13



Lack of pedestrian facilities at Ch.+13 to Ch.+15



Invisible road sign within Ch.+29 to Ch.+31



Wrongly designed road sign within Ch.+29 to Ch.+31



Unprotected pedestrian facility on bridge within Ch.+29 to Ch.+31



Risky edge drop within Ch.+31 to Ch.+33



Damaged road sign within Ch.+33 to Ch.+35



Wrongly colored road sign within Ch.+35 to Ch.+37



Improper placement of sign within Ch.+35 to Ch.+37



Broken shoulder within Ch.+106 to Ch.+208



Hazardous median protection block within Ch.+35 to Ch.+37



Risky edge drop within Ch.+35 to Ch.+37



CHAPTER 6

CONCLUSIONS

C ONCLUSIONS

1. Analysis of Crash Type

The analysis of crash type (based on ARI crash database) of the five highways for which road safety audit has been carried out indicates that for the dual carriageway sections of the national highway the predominant crash type is hit pedestrian (46% for Kanchpur-Daudkandi section of N1 and 44% for N5, and 50% for N3) whereas for single carriageway the predominant crash type is head on collision (42% for N6, and 46% for Chattogram-Cox's Bazar section of N1). It can be inferred that dual carriageway has a profound reduction effect on head on collision and speed pedestrian hits increase substantially which means when a single carriageway is upgraded to dual carriageway more attention is required for safe pedestrian crossing.

Table 6.1: Carriageway Wise Crash Type

Road Section	Carriageway Type	Head on Collision	Pedestrian Hit
N1 (Kanchpur-Daudkandi)	Most part dual carriageway	24%	48%
N1 (Chattogram-Cox's Bazar)	Single carriageway	46%	21%
N3 (Gazipur-Mymensingh)	Dual carriageway	13%	50%
N5 (Dhaka-Aricha)	Most part dual carriageway	24%	44%
N6 (Kashinathpur-Rajshahi)	Single carriageway	42%	29%

2. Design Audit

The design drawings related to road safety for the Gazipur-Mymensingh [Roymoni to Mymensingh section] section of 27km roadway was reviewed and it was found that the design and drawings met international standard, and reflective pavement markings and reflective signs have been suggested in the design. Subsequently, during field visit the location and type of signs and markings were checked and were found that implementation has taken place

as per design but contains few discrepancies. The noticeable difference on the design and field implementations are described below:

- 40/50 speed restriction sign was being used throughout the section, which is not defined in the BRTA manual and might be confusing for the drivers.
- In spite of continuous presence of median B1, B4 sign was being used on the road.
- The design had B1 sign where instead it should be B3 sign.
- The design had B3 sign given on multiple locations, which was unnecessary.
- New signs had been used on few locations as per requirement which were not mentioned in the design drawing.
- A total number of 203 road signs was found in this 27km section. 25% of the signs had no reflectability, about 37 had low visibility issues due to vegetation, trees and disturbed condition.
- Centerline and edge line markings were faded in most road section. After entering the Mymensingh district, no road marking was found till the end of the section.
- Pedestrian crossings had faded road markings.
- Raised pedestrian road crossings had no sign and poorly designed which might cause serious hazard for high speed vehicles.
- Median had no paint on this section and reflector was available but not well working.
- The Mymensingh district entrance roundabout had 6 signs where the design mentioned 14 signs.

3. Highway Access Management

During the field visit of the safety audit for 500 km RHD roads, the audit team has observed that most of the road corridor has become chaotic due to lack of highway access management. The unplanned rapid urbanization including illegal encroachment of ROW, absence of bus lay bays, unplanned truck stands and absence of speed change lanes at junctions created obstruction for the safe mobility of the through traffic, built-up areas were not well delineated; moreover, ineffective highway police, and frequent access (both minor roads

and property access) to the highway created further complications. An integrated corridor based road safety management team at field level involving representatives from RHD, LGED, Highway Police and Local bodies is strongly recommended to coordinate and regularly monitor the road safety activities related to a particular highway corridor. A well-defined highway access management policy may focus on the following issues:

- Highway access permit approval process
- Access location guidelines (general requirement, access density, access spacing, distance from intersections, traffic access impact study)
- Requirement of auxiliary lanes
- Signalized intersections
- Access type (permanent, temporary, residential, commercial)
- Cost of access and responsibility.

4. Sustainability Issue

There are some sustainability issues related to road safety activities which are described below:

- Quite often the roadside furniture (traffic signs and pavement markings) once installed under a project are not maintained regularly properly due to shortage of fund. Ideally the maintenance of street furniture should be mainstreamed with overall road maintenance. Annual inventory of signs and markings should be carried out in the field, and damaged or lost items should be included in the road maintenance work.
- Usually road safety campaign is undertaken during the implementation of road safety or road improvement project but no follow-up is made afterwards. It is desirable that campaigns are carried out in an inclusive manner (involving communities like school teachers/students and industry workers) so that it can be sustained by the communities in future.

5. Summary of Findings

Details of audit observations have been given in previous chapters' charts, graphs and tables summarizing the following issues:

- Adequacy, location, condition of traffic signs and pavement markings
- Obstruction due to fixed objects within the clear zone
- Provision of truck stand/bus lay bays
- Delineation on built up areas
- Night time visibility
- Frequency of access
- Pedestrian facilities

It has been observed that shortcomings on all the above mentioned issues prevails at varying degree on all the five roads and mitigation measures have been suggested in the recommendation section.

RECOMMENDATIONS

1. Mitigation Measures

Government has taken a strategy to upgrade all the national highways to dual carriageway in phases. The audit team has proposed three mitigation strategies: immediate, midterm and long term measures which need to be implemented on a corridor based approach with the involvement of other stakeholder agencies and user groups (LGED, Highway Police, local communities and NGOs involved in road safety):

- **Immediate measures** will involve restoration of shoulder, fixation of sign post, pavement markings, delineation of built-up areas, improvement of pedestrian facilities, provision of bus bays at required locations, strengthening enforcement, and safety campaign to local communities. Immediate measures can be taken for all the five audited highways. Immediate measures should be taken within a year (based on detail investigation comprising of traffic survey, topographic survey and community feedback for pedestrian crossings).
- **Midterm measures** will consist of provision of speed change lane at junctions including channelization where required, provision of truck stands, service roads in built-up areas (following the principles of the

highway access management policy) channelization of junctions, provision of right turn lane through widening road sections (where right turning volume is high), pedestrian over bridge and provision of overpass at very congested location to facilitate movement of through traffic. Midterm measures will not be required where RHD has a program to upgrade the road to dual carriageway within next two years.

- **Long-term measures** will consist of provision of grade separation at important junctions, underpass for pedestrians, flyover at congested part of built-up areas, and separate lane for slow moving vehicles. Long term measures are proposed where upgrading to dual carriageway is not upcoming within next five years.
- **Preliminary quantity for carrying out** immediate physical measures have been estimated which need to be validated further during implementation stage and is given in the following table:

Table 6.2: Preliminary Quantity for Immediate Measures

Name of Audited Highway	Additional Shoulder (km)	Additional Signs (Nos)	Pavement Markings (km)	Bus Lay Bays (nos)	Built-up Area Delineation (km)
N1 (Kanchpur-Daudkandi)	18.1	470	1.5	7	4.3
N1 (Chattogram-Cox'sBazar)	184.6	1930	112	25	16.1
N3 (Gazipur-Mymensingh)	48.8	2161	5.4	4	16.5
N5 (Dhaka-Aricha)	13	1509	15.9	8	16
N6 (Kashinathpur-Rajshahi)	98.4	3041	106.9	15	28.7
Total	362.9	9111	241.7	59	81.6

2. Training Program

Globally Road Safety Specialists are in short supply, Bangladesh is also no exception to this. Road safety knowledge needs a very specialized skill as such there is a strong need for preparing an effective training program for RHD staff. There is a need to mainstream road safety practices at field level. The training program can be organized based on the following principles outlined below:

- **Basic training program** for field staff may include familiarization of road safety manuals and guidelines, and basic design principles of intersection design
- **Advance training program** for RHD's dedicated road safety team may include road safety audit, highway access management, accident analysis, and impact monitoring techniques

3. Institutional Issues

Government has set a target of reducing road crash by fifty percent by 2020. (within the Decade of Action for Road Safety). Moreover, a target has also been set for improving road safety situation by 2030 as part of Sustainable Development Goal (SDG), in order to achieve these targets, the government must implement coordinated and concerted action plan. Reduction of road safety hazards needs multi-disciplinary intervention for which effective coordination is required among stakeholders. For realizing these objectives, National Road Safety Council was established in 2020. Moreover, special institutions (Accident Research institute and Highway Police) have been established, the effectiveness of these needs to be reviewed as part of future road safety study/project. RHD has taken initiative in carrying out road safety audit and strengthen the Road Safety Circle. **Road safety audits should be carried out at design stage, construction stage, post-construction stage, and also periodically: and on specific section of roads (based on the analysis of the annual crash statistics). After implementing road safety mitigation measures there is also a strong need for an impact study to obtain feedback of the intervention.** In order to bring synergy among multi-disciplinary stakeholder agencies and to obtain maximum benefit. a corridor based integrated road safety project (encompassing, physical intervention, enforcement, safety campaign for road users, drivers' training, community

participation, and health sector interventions) can be piloted in a selected priority corridor. This strategy has been used for some World Bank funded projects in Asia and the result is encouraging.

4. Updating of Policies, Manuals and Guidelines

Bangladesh is a unique country, although car ownership is much less compared to many countries, the high population density has resulted unplanned urbanization adjacent to road (sometime within ROW) thereby creating obstruction for the through traffic, and huge demand for pedestrian crossings. Modal share for road transport (which is more than 80% for both passenger and freight traffic) is biased towards road transport, moreover less than 15% of national highway is dual carriageway although they carry about 70% of traffic. There are also some emerging issues described in paragraph below for which new policy and guideline may be required. RHD can take initiative to update existing policy and guideline; and develop new policy and guideline some of which are described below:

- Safety policy for PPP funded road project
- Safety policy for motorcycle
- Pedestrian first policy
- Hawker policy
- Road hierarchy policy
- Updating of road safety guideline and manuals

5. Emerging Issues

Currently GDP growth in Bangladesh is more than 7% which is manifested by rapid development of road infrastructure and increase in the growth of motorized vehicles, which has created new challenges for RHD related to road safety. Some of the emerging issues for which RHD needs to adopt are outlined below:

- **Due to increase in the purchasing power of people the number of motorcycle is growing rapidly in Bangladesh (annual growth rate is more than 20%).** Their large presence can be noticed on highways especially, as part of suburban trips around Dhaka and major district towns. Countries like China, Malaysia, Philippines, and Vietnam also

experienced the same phenomenon growth of motorcycle in their major cities. Some of these countries have provided separate lanes on highways where large number of motorcycles are present and has become the major cause of crashes. RHD should try to address this issue through new policy and regulation before the situation aggravates further.

- Several elevated expressways are now under implementation, some by private sector, even for the public sector financed expressways the operation and management (including toll collection) will be done by private sector. According to international practice some of the road safety activities (maintenance and replacement of signs and markings, incident management, towing of damaged vehicles, and management of trauma center) are carried out by O&M company as part of their contract. RHD may need to prepare a policy and guideline for this purpose.
- Presently digital roadside advertisement display board is becoming a fashion in major cities; very soon it may be seen in built-up locations or at exit/entry point of national highways. These display boards distract the attention of drivers and may cause crashes. RHD should enact a policy guideline in this regard.

FOLLOW-UP ACTION

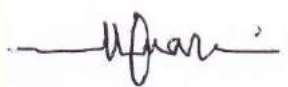
RHD should continue their current initiative of road safety activities and implement the following action:

- Prepare action plan for implementing immediate measures for priority road sections of the audited roads
- Complete the safety audit of the remaining national highways
- Prepare a strategy for safety audit with provision of adequate budget
- Carry out impact studies for completed road safety projects (including road user satisfaction survey).
- Review existing policy and guidelines; and update, if required
- Carryout training need assessment for imparting road safety training to RHD staff

- Impart training to mainstream road safety at field level
- Prepare a report on road safety related projects and training conducted during last ten years which will guide preparation of a five-year road safety plan for RHD
- Prepare a web based newsletter of Road Safety Circle to disseminate information
- Prepare annual report on road safety activities
- Carry out periodic review of the road safety targets in MDG and SDG.

AUDIT TEAM STATEMENT

The road safety audit was carried out by the audit team using all the available material as per references and stated on Chapter 4. Every effort was made to ensure that all safety issues were considered. The above safety audit findings and recommendations are the opinion and judgement of the audit team.



Date: 30.06.2018

Mohi Uz Zaman Quazi

Team Leader

Senior Road Safety Auditor

CHAPTER 7



PHOTO GALLERY

Figure-1: Inception meeting with RHD Road Design & Safety Circle

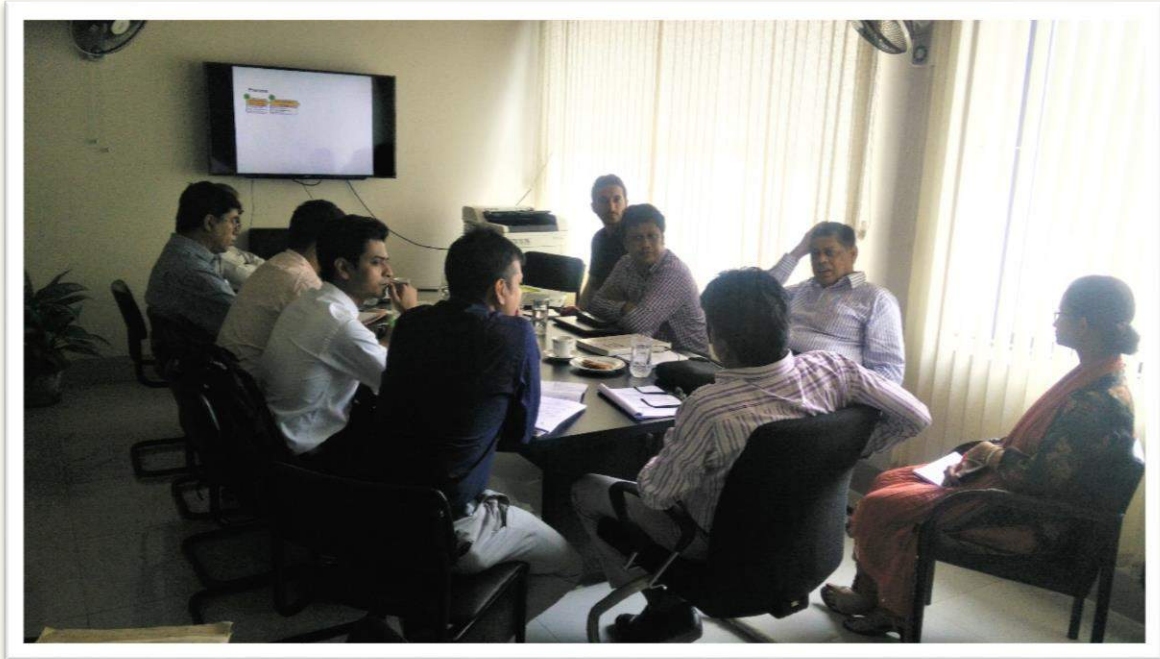


Figure-2: Inception meeting with RHD Road Design & Safety Circle



Figure-3: Field activity



Figure-4: Field activity



Figure-5: Field activity



Figure-6: Mishaps on surveyed N3



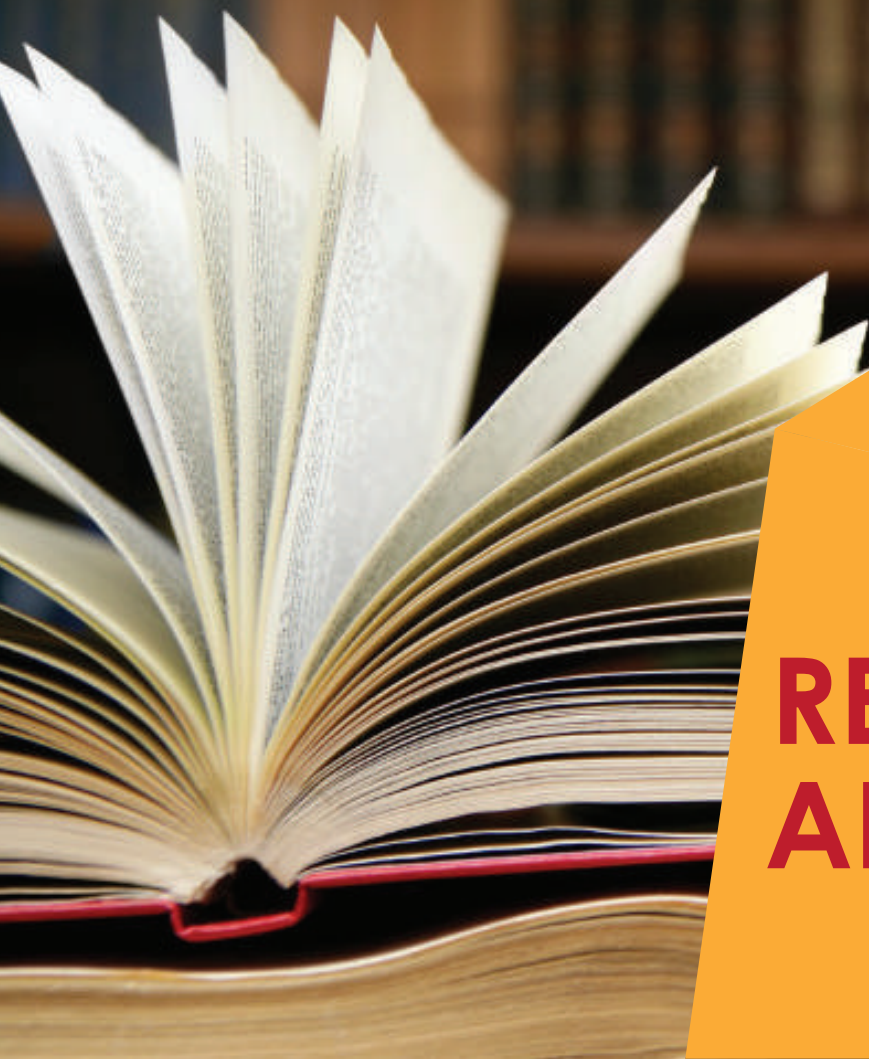
Figure-7: Field activity



Figure 8: Field test by RSA team



CHAPTER 8



**REFERENCES
ANNEXURES**

REFERENCES

AASHTO, Highway Safety Design and Operations Guide 1997, Washington, D.C.

AUSTROADS , Road Safety Audit (1994), Austroads , Sydney, Australia.

FHWA Road Safety Audits Guidelines (2006).

Hoque, Md M. (2013). Pedestrian Safety: The Bangladesh Context. Workshop on Effective Engineering Treatment to improve Pedestrian Safety. April 2-4 2013. GRSP/Irap

IRC: SP: 88-2010. "Manual on Road Safety Audit". Indian Road Congress, New Delhi, India.

RHD Road Geometric Design Manual 2005

RHD Road Safety Engineering Toolkit 2005

Singh, P. K. (2011). Road Safety Audit for Four Lane National Highways.

ANNEXURE-A

Site Specific Intervention Locations



SITE SPECIFIC INTERVENTION LOCATIONS

SIGN

Common Problem Observed

- Sign was required but unavailable
- Sign was broken
- Sign was less visible
- Sign was at inadequate distance from the object

CHAINAGE WISE OBJECTED SIGN ON N1

Sign Having Visibility Problem

341.1	289.7	311.0	345.1	281.8
257.8	360.9	284.6	368.1	337.4
367.8	281.6	322.6	308.4	322.0
307.4	344.0	277.4	299.7	340.3
299.1	332.0	348.3	312.8	337.5
311.9	257.9	315.9	275.6	337.6
284.6	266.9	281.8	275.6	
297.4	365.2	297.9	340.9	
334.9	308.1	353.3	327.8	
260.5	306.7	344.8	352.6	
295.9	299.8	331.8	342.5	

Sign Having Distance To Object Problem

307.4	306.7	281.8	292.7	282.1
284.6	299.8	331.8	302.2	354.2
297.4	311.0	299.7	282.1	354.3
332.0	284.6	312.8	354.2	

CHAINAGE WISE OBJECTED SIGN ON N6**Sign Having Visibility Problem**

9.0	28.3	72.3	93.4	99.3
9.3	28.7	72.4	93.5	99.4
16.6	49.1	73.2	93.5	104.6
17.6	57.0	73.2	93.7	105.8
18.2	60.0	73.5	93.8	113.5
18.5	64.8	73.5	93.8	125.9
22.7	65.4	73.8	93.9	127.5
23.1	68.0	73.8	93.9	132.0
23.4	72.1	81.2	98.0	132.3
24.0	72.2	93.4	99.0	132.4
				132.5

Sign Having Distance To Object Problem

307.4	306.7	281.8	292.7	282.1
284.6	299.8	331.8	302.2	354.2
297.4	311.0	299.7	282.1	354.3
332.0	284.6	312.8	354.2	

Broken Signs

57.4	56.5	113.6	140.6	140.8
132.3				

CHAINAGE WISE OBJECTED SIGN ON N3**Sign Having Visibility Problem**

22.4	55.7
22.7	61.0
24.4	61.7
25.3	73.1
25.4	76.9
26.0	77.8
26.5	81.1

CHAINAGE WISE OBJECTED SIGN ON N3

29.4	82.2
30.9	82.2
36.9	83.2
38.9	83.4
39.2	85.8
41.6	88.3
41.7	92.4
44.3	92.7
44.7	93.6
45.1	93.7
45.3	93.8
45.5	94.1
45.9	94.7
46.5	95.9
46.8	96.6
47.0	96.8
48.8	98.7
51.1	99.5
52.4	102.4
52.9	105.3
53.5	

Sign Having Distance To Object Problem

24.4	59.8	60.8
------	------	------

Broken Sign

25.4	51.7	77.7
33.6	54.2	89.4
35.4	59.1	101.0
44.1	66.4	

CHAINAGE WISE OBJECTED SIGN ON N5**Sign Having Visibility Problem**

7.2	26.2	43.5
7.5	33.1	44.6
12.0	34.9	69.7
12.2	38.8	69.7
20.6	42.8	
Sign Having Distance To Object Problem		
12.0	26.2	43.5
12.2	42.8	

CHAINAGE WISE OBJECTED SIGN ON N1(KANCHPUR)**Sign Having Visibility Problem**

14.1	15.8
Sign Having Distance To Object Problem	
30.8	35.4

**ADDITIONAL REQUIRED SIGN SUGGESTION
N1 (KANCHPUR)**

Type of Sign	Sign Required (Nos)
A1	40
B3	68
B5	36
B23	94
B31	68
C2	96
A26	11
A20	17
A30	24
B25	2

C31	2
B10	2
B13	7
Total	470

N5

Type of Sign	Sign Required (Nos)
A1	138
B3	219
B5	115
B23	304
B31	236
C2	306
A26	49
A20	39
A30	76
B25	4
C31	7
B10	7
B13	9
Total	1509

N1 (Chattogram-Cox'sBazar)

Type of Sign	Sign Required (Nos)
A1	125
B3	216
B5	109
B23	292
B31	218
C2	292
A26	69
A20	70
A30	74

B25	22
C31	6
B10	200
B13	237
Total	1930

N3

Type of Sign	Sign Required (Nos)
A1	223
B3	371
B5	189
B23	464
B31	311
C2	473
A26	47
A20	96
A30	96
C31	20
B10	25
B13	46
Total	2361

N6

Type of Sign	Sign Required (Nos)
A1	257
B3	412
B5	206
B23	553
B31	385
C2	558
A26	126
A20	123
A30	146

B25	40
C31	15
B10	106
B13	114
Total	3041

ADDITIONAL REQUIRED SIGN SUGGESTION LOCATIONS

N1

Chainage	Sign Type	Chainage	Sign Type
252.1	B1	316.2	B25
252.2	B1	316.6	C4
257.2	B24	331.9	C21
257.4	C4	332	C4
259.1	C4	336.7	C4
261.3	B24	343.5	B1
261.5	B24	344.5	B25
264.3	C4	344.8	B25
268.2	C11	349.6	B25
276.4	B10	352.8	B25
282.7	B35	353.2	B13
283.1	B1	355.1	B13
283.2	B1	355.6	B25
283.8	B10	356.5	C13
284.4	C28	356.8	C4
284.8	B31	357.5	C4
289	Built up	357.8	C4
289.9	Bazar	357.9	Bazar
290.9	B10	358.4	B25
291	B10b	360.4	B10a
291.2	B10a	360.9	B25
292.9	B10b	363.4	C4
293.3	B13	363.8	C17
294.7	B10b	367.3	C13
295	B10b	368	B25
295.3	B10a	371.2	C9
295.7	B10a	371.4	C4
296.8	C4	371.5	C13
297	B10a	373.6	B25
297.8	B10a	374.8	C13
301.2	B31	375.4	C4

302.1	B25	377.5	B25
302.2	B25	377.6	C4
302.9	C4	379.2	B25
311	B13	379.7	B25
312	B13	380.2	B25
316.1	B25	380.3	B25

ADDITIONAL REQUIRED SIGN SUGGESTION LOCATIONS

N5

Chainage	Sign Type	Chainage	Sign Type
1	C4	1.2	C4
1.1	C4	2.8	C4
5.1	C4	3.1	C4
6	C4	3.2	C4
7.7	C4	3.9	C4
11.4	B11a	4.6	B35
12.4	C13	5.3	B3
12.8	B11a	8.8	C4
16	B11a	12.1	B11a
17.4	B11a	12.6	B11a
17.6	B11a	14.3	B11a
19.8	B11a	14.7	B11a
20	B11a	16.4	B11a
29	C4	16.8	B11a
29.1	C4	18.2	B11a
30.6	C4	19.9	B11a
31.4	Busbay	20.7	B11a
31.5	C4	31.1	C4
35.9	C4	31.3	C4
37	C4	34.6	C4
38.6	C4	36	C4
54.8	C4	43.4	C4
54.9	C4	49.3	C4
62	C4	52.9	C4

ADDITIONAL REQUIRED SIGN SUGGESTION LOCATIONS

N3

Chainage	Sign Type	Chainage	Sign Type
21.9	C4	60.2	C4

ADDITIONAL REQUIRED SIGN SUGGESTION LOCATIONS

22.1	C4	61.1	B11
23.4	C4	61.2	B3
24	C4	61.5	C4
24.7	C4	68.1	C4
27.9	C4	70.7	B3
28.8	C4	71.7	C4
29	C4	73	B12
29.3	C4	76.1	C4
30.2	C4	78.6	C4
31.4	C4	80.7	B3
32.1	B10L	83	B35
32.4	B10R	84.5	C4
33	B4	89	B35
33.7	C21	90.6	C4
36.9	C4	91.3	C4
38.6	C21	92.1	B3
42.4	C4	99.5	C4
42.5	B3	99.9	B10R
46.3	C4	99.9	B10R
47.2	C4	101	C4
49.4	C4	101.8	B10R
54	C4	105.5	B10
54.1	C4	107.1	C4
54.3	B11	107.3	B25
56.8	C4	107.4	C21
59.6	C4	108	B25

ADDITIONAL REQUIRED SIGN SUGGESTION LOCATIONS

N6

Chainage	Sign Type	Chainage	Sign Type
0.1	C28	70.4	B13
0.5	B25	70.9	B13
0.8	B3	72.9	B13
1.7	B13	75.4	B12
2.2	B13	79.6	B3
3.2	B3	81.7	B10
3.5	C21	83.3	B9, B13
3.6	B4, B25	84.2	B3
4.3	B3	85.8	A20
4.6	C21	88.5	B3
4.8	B4	88.9	B3

ADDITIONAL REQUIRED SIGN SUGGESTION LOCATIONS

5.7	BC	89.9	B3
6	B13	90.4	B13
6.3	B13	91.2	B13
6.4	B3	91.7	B3
6.7	C21, B4	92.8	B13
7.4	B4	93.8	B3
7.6	B3	94.1	C4
8.3	B3	95.8	B3
9.1	B13	97	C4
9.3	B13	97.5	B10
9.8	B4	97.6	B3
9.9	B3	98.5	B10R
10.2	B13	99	C4
10.8	B3	100.1	B3, C21
10.9	B13	100.6	C4
11.3	B13R	100.7	B3
12.7	C21, B23	101.1	B10R
14.8	B13, B3	102.8	B10
15.1	B12	103	B10
15.9	A32	103.6	B10R
18.1	B4	104.3	B3
18.9	B10	104.5	B3
19.3	B3	104.9	B45
21	B10	105.4	B10R
21.3	B10	107.1	B3
21.6	B4	107.7	B3
21.9	B10	107.9	B3
22	A26	108.5	B13, B3
22.2	C18	108.8	B3
22.4	B10	112.6	B10R
22.9	A12	112.8	B3
23.7	B12	113.3	B3
24.4	B3, B25	114.4	B10
24.7	B3, B25	115.1	B10
25.3	C21	116.4	C4
25.4	B10	116.8	C21
26	B4	117	B3, B23
28.1	B10	117.3	B12
28.3	B4	117.8	B10
28.6	B12	118	B10R
29.1	B12	118.1	B3
30	B3	118.2	B10
30.5	B13	119.1	C21

ADDITIONAL REQUIRED SIGN SUGGESTION LOCATIONS

31.4	B4	119.2	B3, B23
32	B13	119.4	B3
33.2	C21, A20, A26, B36	119.7	C4
34.2	B13	119.9	B3
35.1	B3	120.4	B3, C4
36.8	B13	121.4	B3
37	B3, B36, A20 A26	121.7	C21
37.5	C21, B23	123.7	B10
39.4	A20, A25, B36	124	B3
39.8	B3	124.4	B10
39.9	B13	125.9	B12
40	B4	126.6	B3
41.3	B45	126.9	B10
41.4	B3	127.9	B10
41.7	B9, C21	128.2	B10
42.1	B3	128.4	C4
42.3	B3	130	B10
42.5	B3	130.1	B3
43.5	C4	130.2	B10
43.6	B3	130.6	B10
44	B4	130.9	B10
44.1	B13	131.9	B3
45.1	B4	132.3	C4
45.5	B4	132.6	B10
45.8	B4	133.8	B3
46.1	B9	134.2	B3
46.3	C28	134.8	B3
46.5	C21, B3	135.5	B3
47.2	B12	136	B3
47.7	B10	136.7	B3
48.2	B13	137	B3
48.8	B13	137.5	B3
48.9	B3	137.6	B23
49.3	B25	138.1	B23
49.5	B13	139.5	B3
51.6	B3	139.6	C4
52.1	B12	140.3	B3
52.4	B3	140.7	B3
53	B10	140.9	B23
53.8	B10, B3	141	B3
54.8	B3	141.4	B10

ADDITIONAL REQUIRED SIGN SUGGESTION LOCATIONS

55.1	B10	141.7	B3
55.5	B3	141.9	B3
57	B36, A26, B31	142.5	B9
57.2	B3	144	B9
58.4	B10	144.6	B3
58.9	B3	145	C4
59.3	B12	145.4	B3
59.9	B3	145.8	B9
60.1	B13	146.2	B9
60.4	B13	146.4	B3
60.8	B13	146.9	B9
61	A20, A26, B36	147.2	B3
61.4	B9	51.6	B3
61.9	B45	52.4	B12
62.8	B3	61.9	B9
64.6	B13	81.7	B10
65.7	B3	91.7	B3
66.6	B3	94.1	C4
66.7	A20, B36, A26	97	C4
67.3	B3	97.5	B10
68.6	B13	97.6	B3
68.7	B3	98.5	B3
69.1	B13	99	C4
69.5	B13	103	B10R
70.2	B3	104.5	B3
4.8	C21	107.9	B3
7.6	B4	112.8	B10
8.3	D3	114.4	B3
9.3	C21	116.4	C4
21	B10	117	B23
21.3	B10	117.3	B3
22.2	C18	118	B10R
25.3	C4	118.2	B10
26	A26	119.2	B23
28.1	B3	119.4	B3
28.6	B4	119.7	C4
37	B13	120.4	C4
37.5	C21, B23	125.9	B12
40	B13	127.9	B3, B10
41.3	B3, B45	128.4	C4
41.4	B10	137.6	B23
42.3	B3	138.1	B23
44	C21	139.6	C4

ADDITIONAL REQUIRED SIGN SUGGESTION LOCATIONS

46.3	C28	142.5	B3
46.5	C21	145	C4
49.5	B13	146.4	B9

ADDITIONAL REQUIRED SIGN SUGGESTION LOCATIONS**N1(Kanchpur)**

Chainage	Sign Type	Chainage	Sign Type
10.3	B11a	20.6	C4
10.7	C4	21.2	C4
11.3	C4	21.9	C4
13.3	U-Turn	26.1	C4
13.6	C4	26.4	C4
15.4	C4	26.8	C4
18.4	C4	27.8	B11a
18.5	C4	28.9	C4
18.6	U-Turn	30.3	C4
19.5	B11a	30.9	B11a
19.6	C4	31	C4
20.5	C4	32.7	C4

BUS BAY**Common Problems Observed**

- Absent in most of the cases where required
- Bus bay of inadequate width
- Absence of advance signs and markings
- Illegally occupied

BUS BAY REQUIRED ON N1

284.6	266.9	256.8	327.2	354.6
252.1	380.0	262.7	341.9	363.9
260.3	283.1	271.3	344.7	367.6
282.5	251.5	307.6	350.1	371.6
375.2	253.0	323.8	351.9	
Bus Bay Needing Intervention				
322.1		331.9		332.0

BUS BAY REQUIRED ON N6

12.1	37.5	9.0
12.2	37.6	97.5
25.3	51.5	129.3
28.4	83.9	140.7
32.5	84.0	144.0
Bus Bay Needing Intervention		
12.1	37.5	97.5
12.2	37.6	129.3
25.3	51.5	140.7
28.4	83.9	144.0
32.5	84.0	

BUS BAY REQUIRED ON N3

21.8		26.8
25.5		33.7
Bus Bay Needing Intervention		
28.1	41.8 - 41.9	89.4-89.5
33.5-33.8	44.2-44.7	89.5-91.3
36.7-36.8	45.2-45.5	
38.7-39.2	54.3-54.9	
40.5-41.1	56.8-57.3	
41.5-41.8	60.9-61.6	

BUS BAY REQUIRED ON N5

0.6	9.5	19.5
4.9	11.2	42.2
6.6	13.4	
Bus Bay Needing Intervention On N5		
12.1	27.1	29.8
27.0	29.7	

BUS BAY REQUIRED ON N1 (KANCHPUR)

11.9	28.8	
27.8	7.0	
30.9	15.9	
16.7		
Bus Bay Needing Intervention On N1 (Kanchpur)		
19.9	11.9	20.0

BUILT-UP AREA**Common Problems Observed**

- No welcome or warning sign
- Lack of pedestrian facilities
- No speed limit sign or calming devices
- Poor night time lighting condition

BUILT-UP AREA THROUGH N1

250.5-250.7	277.9-278.1	307.5-307.7	357.4-357.8
252.0- 252.4	278.9 -279.1	315.6-315.8	363.8-364.0
260.3-260.5	281.5-282.5	322.0-322.1	367.6-367.9
261.3-263.0	283.1-283.4	330.0-332.0	373.3-373.5
263.0-264.9	284.4-284.8	333.0-333.3	375.1-375.3
266.6-267.0	289.0-290.1	341.9- 342.0	379.9-380.2
271.2-272.0	296.3-297.0	344.7-345.0	381.2-382.4
272.7-273.2	297.1-297.6	350.1-350.3	
273.9-274.2	301.0-301.8	351.8-352.0	
274.5-275.8	304.3-304.7	354.6-355.0	

BUILT-UP AREA THROUGH N6

8.7-9.7	57.0-57.45	98.9-99.4	128.0-129.6
12.0-12.6	61.0-62.0	100.0-101.2	137.3-137.8
16.3-16.9	66.75-68.0	106.0-106.3	140.18-141.0
24.8-25.7	68.0-68.4	116.5-117.1	141.8-142.0

BUILT-UP AREA THROUGH N6

33.0-33.5	83.5-84.0	119.0-119.7	142.0-144.0
36.9-37.5	84.0-84.5	121.6-122.0	144.0-146.0
41.4-42.0	89.3-90.0	123.9-124.0	146.0-148.0
42.0-44.0	90.0-90.2	124.0-124.2	
44.0-44.6	93.3-93.85	124.6-124.9	
50.9-52.0	97.4-98.0	126.0-126.7	

BUILT-UP AREA THROUGH N3

24.5-24.7	41.8-42.9	56.6-57.6	77.4-77.5	104.2-105.5
36.5-36.7	44.1-44.8	60.8-61.6	77.5-77.8	106.8-107.5
38.6-39.1	50.5-51.0	68.8-69.5	79.2-79.3	107.5-109.5
40.5-41.1	52.4-53.6	69.5-70.5	89.5-90.7	109.5-110.2
41.5-41.8	54.2-54.9	73.8-74.2	95.0-95.2	

BUILT-UP AREA THROUGH N5

0.3-1.4	10.0-12.0	29.7-29.9	43.5-43.6	65.5-65.8
4.4-5.2	12.0-14.0	33.1-33.3	45.3-45.5	70.0-71.3
5.8-6.0	25.3-25.8	37.3-37.5	50.1-52.0	78.0-78.3
6.0-8.0	26.2-27.3	42.1-43.3	64.4-64.6	

BUILT-UP AREA THROUGH N1(KANCHPUR)

7.0-9.0	20.0-20.2	30.1-31.0
19.4-20.0	22.4-22.8	31.0-31.2

PERMANENT OBJECTS ON CLEAR ZONE OF N1

Left Side		Right Side	
309.6		273.2	309.8
309.7		274.6	310.1
		288.0	310.2
		275.3	319.6

PERMANENT OBJECTS ON CLEAR ZONE OF N1

		295.9	319.6
		297.3	348.9

PERMANENT OBJECTS ON CLEAR ZONE OF N6

Left Side

Right Side

0.3	61.2	8.9	124.7
12.1	61.3	9.0	124.8
12.2	68.1	9.4	124.9
21.3	68.2	9.5	126.7
21.4	90.0	9.6	126.8
21.5	124.1	12.1	128.1
25.0	124.2	12.2	128.4
25.1	124.7	12.3	128.5
37.1	126.7	22.1	128.6
37.2	126.8	22.2	128.7
37.3	128.9	22.3	128.8
37.4	129.0	22.4	128.9
37.5	129.1	25.0	129.0
37.6	129.2	25.1	129.1
37.7	129.3	28.5	129.2
51.3	129.5	37.1	129.3
51.4	142.0	37.2	129.4
51.5		37.3	129.5
		37.4	129.6
		37.5	131.8
		37.6	132.3
		42.3	139.7
		51.3	142.0
		51.4	142.1
		51.5	142.2

PERMANENT OBJECTS ON CLEAR ZONE OF N6

Left Side

Right Side

		60.0	144.1
		61.2	144.2
		61.3	144.3
		107.0	144.4
		124.1	144.5
		124.2	144.7

PERMANENT OBJECTS ON CLEAR ZONE OF N3

Left Side

Right Side

26.8	104.5	28.1	110.0
27.7	106.1	90.1	110.1
32.4	107.7	90.2	110.2
47.0	107.8	90.3	
47.1	107.9	90.5	
57.4	108.4	107.8	
57.5	109.5	107.9	
81.3	109.6	108.0	
95.3	109.7	108.1	
97.0	109.8	109.5	
101.1	109.9	109.6	
101.4	110.0	109.7	
102.4	110.1	109.8	
104.4	110.2	109.9	

PERMANENT OBJECTS ON CLEAR ZONE OF N5

Right Side

1.2	12.9
2.2	24.9
2.3	55.6
5.8	56.6

TREES ON CLEAR ZONE OF N1

Left Side		Right Side	
301.0	299.6	303.7	298.1
301.1	300.3	253.1	303.5
301.2	300.5	255.2	305.4
289.5	300.6	255.5	338.7
289.6	300.8	255.9	342.1
289.7	301.3	256.3	
290.5	309.1	265.6	
290.7	312.6	271.6	
299.3		297.4	

POLES ON CLEAR ZONE OF N1

Left Side		Right Side	
309.6	338.2	306.5	320.4
309.7	338.6	320.6	321.6
301.8	339.1	329.7	321.7
380.2	340.3	337.4	325.7
279.7	347.2	337.5	325.8
280.4	347.3	350.0	325.9
303.0	348.4	352.5	326.1
303.7	348.5	289.7	327.3
304.1	348.6	273.2	329.6
306.5	350.0	253.3	333.5
307.1	352.5	254.1	334.8
308.0	352.9	254.6	339.3
308.1	354.8	257.8	339.9
313.5	354.9	258.3	342.8
313.6	355.0	260.1	343.0
315.8	356.9	261.5	350.5
315.9	358.0	267.1	350.6

POLES ON CLEAR ZONE OF N1

320.6	358.1	267.2	352.1
321.9	359.7	267.3	352.2
323.1	359.8	268.1	352.7
326.0	359.9	269.4	353.2
326.3	360.0	280.7	354.2
326.4	360.4	281.2	358.8
326.8	360.6	282.6	358.9
326.9	362.9	283.1	362.1
327.5	368.0	286.0	363.3
328.6	368.1	286.4	365.4
329.7	368.3	289.4	365.5
330.5	368.5	290.2	370.1
330.6	369.3	290.6	376.5
330.7	369.4	295.1	
330.8	369.5	296.0	
334.5	369.8	297.1	
334.9	369.9	299.5	
335.3	371.5	300.2	
337.4	376.8	303.1	
337.5	378.3	303.4	
337.6	380.1	306.1	
338.0	380.5	306.8	
338.1		307.9	

TREES ON CLEAR ZONE OF N6

Left Side		Right Side	
2.2		8.5	78.1
21.2		9.3	93.7
22.7		9.4	108.6
51.2		13.4	124.1
74.9		22.3	129.2

75.0		22.7	129.3
137.2		24.0	129.4
144.1		33.0	144.1
144.2		35.6	144.2
144.3		68.6	144.3
144.4		74.9	144.4
144.5		75.0	144.5
144.6		77.5	144.6
144.7		77.8	144.7

POLES ON CLEAR ZONE OF N6

Left Side		Right Side	
144.1	128.8	144.1	128.7
144.2	142.1	144.2	128.8
144.3	21.4	144.3	142.1
144.4	37.7	144.4	145.9
144.5	93.7	144.5	145.5
144.6	142.6	144.6	93.6
142.0	145.9	93.7	93.8
37.1	142.3	129.2	145.6
37.5	145.5	129.3	145.7
25.0	78.7	9.3	145.8
25.1	93.6	77.5	129.1
37.2	93.8	9.5	22.2
37.3	142.4	37.1	22.1
37.4	142.5	37.5	22.4
37.6	145.6	25.0	128.4
51.4	145.7	25.1	128.5
128.9	145.8	37.2	28.3
129.0		37.3	28.4
142.2		37.4	9.1
128.6		37.6	30.8

		128.9	103.5
		129	103.6
		142.2	

TREES ON CLEAR ZONE OF N3

Left Side	Right Side
109.3	28.1

POLES ON CLEAR ZONE OF N3

Left Side	Right Side
22.4	29.9
23.8	51.5
27.0	62.9
27.1	63.5
27.2	65.4
28.1	66.9
28.2	70.2
29.8	70.3
29.9	70.5
31.7	80.1
31.9	80.5
32.1	80.9
32.2	81.7
32.3	85.4
38.2	90.1
41.3	90.2
65.3	90.3
65.4	90.5
66.9	99.6
67.3	106.9

POLES ON CLEAR ZONE OF N3	
Left Side	Right Side
67.4	107.0
71.5	107.1
75.5	107.2
77.0	107.3
77.4	107.5
77.5	107.6
77.6	107.7
77.7	107.8
79.0	107.9
82.0	108.0
88.3	108.1
95.3	108.5
95.5	108.6
96.0	108.7
99.7	108.8
104.3	108.9
107.1	109.0
107.2	109.1
107.3	109.2
107.5	109.3
107.6	109.4
107.7	109.5
107.8	109.6
107.9	109.7
108.0	109.8
108.1	109.9
108.2	110.0
108.3	110.1
108.4	110.2
108.5	

POLES ON CLEAR ZONE OF N3	
Left Side	Right Side
108.6	
108.7	
108.8	
108.9	
109.0	
109.1	
109.2	
109.4	
109.5	
109.6	
109.7	
109.8	
109.9	
110.0	
110.1	
110.2	

TREES ON CLEAR ZONE OF N5		
Left Side	Right Side	Right Side
2.1	2.7	46.4
2.2	3.7	46.5
2.3	4.1	46.6
2.4	4.2	46.9
2.6	4.3	47.0
2.7	4.4	47.2
2.8	4.5	47.3
2.9	4.6	47.4
3.0	5.5	49.1
3.1	5.6	49.2
3.3	5.7	49.3

TREES ON CLEAR ZONE OF N5		
Left Side	Right Side	Right Side
3.4	11.0	49.4
3.5	12.5	50.0
3.6	23.4	50.7
3.7	23.9	51.8
3.8	24.5	52.1
4.1	25.7	52.4
4.2	26.5	52.5
4.3	26.7	52.6
4.6	26.8	52.7
15.1	27.5	52.9
23.1	27.7	53.0
24.2	28.2	53.1
24.4	28.4	53.2
24.6	28.7	53.3
25.7	29.0	53.4
26.2	29.3	53.5
26.4	29.6	53.6
26.6	29.7	53.7
27.7	29.9	54.4
28.2	30.0	54.9
28.3	30.7	55.0
29.8	30.8	56.9
29.9	31.0	57.9
30.1	31.3	59.0
31.3	31.4	59.4
31.4	31.5	60.6
31.5	31.6	60.7
31.6	31.8	60.8
35.3	31.9	60.9
37.0	32.1	61.0

TREES ON CLEAR ZONE OF N5		
Left Side	Right Side	Right Side
37.1	32.3	61.1
38.1	35.0	61.6
39.5	35.1	62.1
43.3	35.2	62.4
46.6	35.3	62.6
46.8	35.4	62.8
46.9	35.5	62.9
47.0	35.6	63.0
47.2	36.8	64.1
47.3	37.0	64.8
49.2	37.1	64.9
50.0	37.2	65.0
50.1	38.0	65.1
51.9	38.1	65.3
52.1	38.3	66.7
52.3	38.7	66.8
52.4	38.8	66.9
53.0	39.4	67.1
54.8	39.5	67.2
54.9	39.6	68.4
55.0	40.7	68.6
55.1	40.8	69.2
55.2	41.0	69.3
56.8	41.1	69.4
56.9	41.2	69.5
59.5	41.8	69.7
61.9	42.0	70.4
63.1	42.1	70.5
63.7	42.5	72.2
64.7	42.6	73.2

TREES ON CLEAR ZONE OF N5

Left Side	Right Side	Right Side
67.1	43.3	73.3
67.2	43.4	75.4
67.3	44.2	76.5
67.4	45.0	76.9
77.0	45.8	77.3
77.1	45.9	
77.2	46.1	
	46.2	

POLES ON CLEAR ZONE OF N5

Left Side	Right Side	Right Side	Right Side	Right Side
0.2	35.1	75.6	12.3	46.3
0.8	41.0	24.2	12.4	47.7
0.9	43.4	24.4	14.0	48.9
1.6	45.0	50.1	15.9	49.6
7.8	46.1	55.1	16.1	50.4
9.5	46.6	77.1	16.6	55.5
9.7	46.2	77.2	16.7	60.1
12.7	46.4	15.8	19.3	62.3
12.8	47.4	12.1	19.4	63.4
13.0	49.4	71.3	20.6	63.8
13.1	47.0	1.4	20.7	64.4
24.7	53.3	15.2	23.0	67.0
24.8	60.9	16.2	24.0	67.6
25.0	12.9	20.1	24.3	69.6
25.1	24.9	26.0	25.4	72.1
31.0	32.2	41.4	25.5	72.4
41.5	58.3	71.0	27.3	72.5
41.6	74.5	71.8	28.0	72.9
46.7	9.7	34.6	28.1	74.4

POLES ON CLEAR ZONE OF N5				
Left Side	Right Side	Right Side	Right Side	Right Side
49.7	41.5	40.9	28.6	74.9
54.5	41.6	44.7	28.8	75.9
54.6	53.0	47.6	32.6	76.4
58.3	55.0	48.6	32.7	
60.2	50.0	51.7	33.3	
60.3	51.8	58.2	33.4	
63.5	46.7	1.5	34.8	
67.8	49.7	9.1	42.9	
67.9	54.5	9.3	43.0	
74.5	26.7	9.6	44.4	
75.6	63.5	12.2	44.6	

TREES ON CLEAR ZONE OF N1 (KANCHPUR)	
Right Side	29.4

POLES ON CLEAR ZONE OF N1 (KANCHPUR)	
Left Side	Right Side
12.9	10.8
16.0	11.1
20.9	15.6
21.0	15.7
	16.1
	19.4
	29.2
	32.0

PAVEMENT CONDITION ON N1	
Potholes	
263.1	300.7
300.1	300.8

PAVEMENT CONDITION ON N1	
300.3	354.6
300.5	356.7
300.6	
Waterlogging	
252.1	358.5
252.2	361.1
252.3	361.2
252.4	361.5
317.5	362.9
318.6	363.7
318.8	363.9
357.6	366.6
357.7	368.7
357.8	

PAVEMENT CONDITION ON N6	
Potholes	
54.0	74.9
64.5	77.0
Waterlogging	
56.0	85.4

PAVEMENT CONDITION ON N3		
Potholes		
61.6		78.2
Waterlogging		
21.9	85.8	87.4
22.2	85.9	
85.7	86.0	

PAVEMENT CONDITION ON N5

Potholes		
6.8	7.0	12.9
6.9	12.5	59.8

PAVEMENT CONDITION ON N1 (KANCHPUR)

Potholes		
17.5		26.2
18.7		26.3
18.8		28.9
18.9		29.1
19.3		29.3
19.6		29.5
19.7		31.8
19.8		31.9
19.9		33.6
21.2		33.7
25.9		37.9
26.0		38.0
26.1		38.2
Waterlogging		
25.5		25.7

ANNEXURE-B

Meeting Minutes Of
Commencement Meeting



MINUTES OF COMMENCEMENT MEETING

May 03, 2018

Minutes of Commencement Meeting

Project

"Detailed Road Safety Audit of Road Sections of Joydebpur – Mymensingh (N3), Kachpur- Daudkandi (N1) and Chattogram – Cox's Bazar (N1), Kashinathpur – Rajshahi (N6) and Dhaka – Aricha (N5) (Total 500 km) National Highway during FY 2017 -2018 "

Meeting Agenda

- Finalise the work plan for the road safety audit
- Finalize the field survey method and the adequacy of the proposed data requirements with RHD road safety audit guidelines
- Submission of draft Inception report
- Finalize the project timeline
- Comments from client on the overall status

Discussion Point and Decision

Detected road issues must be specified in the audit report
All signs must be specified according to BRTA manual and design standard has to be provided to the field survey team
Bridge and intersection LRP will be noted during survey
Embankment height will be addressed by visual estimation
Good practice of roadway environment will be noted during the survey
In Built up area, dominating mode of travel and availability of speed calming devices will be addressed
Location, usability and warrant of Bus bay may be identified
Median width, end treatment, gap and condition of median environment may be addressed

May 03, 2018

Availability of drainage facilities, auxiliary lane, space adequacy during turning, objectionable road curves may be addressed

Pedestrian facilities in school zones will be checked

Condition of existing road pavement may be addressed

Rough sketch of few major junctions may be provided

Participants:

Name	Title	Company
Engr. A K Mohammad Fazlul Karim	Superintending Engineer (C.C)	Roads and Highways Department, Road Design and Safety Circle, Allenbari, Tejgaon, Dhaka
Mohammad Shaheen Sarker	Executive Engineer	Roads and Highways Department, Road Design and Safety Circle, Allenbari, Tejgaon, Dhaka
Munmun Biswas	Sub-Divisional Engineer	Roads and Highways Department, Road Design and Safety Circle, Allenbari, Tejgaon, Dhaka
Mohi Uz Zaman Quazi	Team Leader	HeptaTech Limited
Mushab Bin Khondker	Project Coordinator	HeptaTech Limited
Probir Gopal Roy	Team Coordinator	HeptaTech Limited
Arif Uddin	Consultant	HeptaTech Limited
Shahriar Sarkar	Consultant	HeptaTech Limited
Kuntal Biswas	Engineer	HeptaTech Limited
M. Hosne R Rafy	Engineer	HeptaTech Limited
Iftekhhar Ahmed	Technical Director	SARM Associates Limited
Pankaz Kumar Ray	Senior Engineer	SARM Associates Limited

May 03, 2018

Action Point and Deadline

Action	Assigned to	Due Date
Traffic data from RHD and crash data from ARI will be collected	Client / ARI	8-May-18
A filed survey schedule will be submitted to RHD	Consultant	8-May-18
A letter to police, RHD local offices will be issued from RHD about facilitation of audit team	RHD	8-May-18
Interim audit report may be submitted addressing more than 200Km road audit details	Consultant	18 June,2018

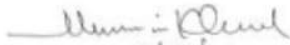
Checklist

Consultant proposed a checklist and a detail discussion took place. Client proposed some of the new ideas, which are mostly incorporated in the checklist. The rest will be addressed by taking notes. The team will have one more group orientation before kicking off the survey.

Attachment:

1. Old Checklist
2. New Checklist

Prepared by


03/05/18.

Mushab Bin Khondker
Project Coordinator
SARM HeptaTech JV

ANNEXURE-C

Filled Checklists of Audited Highways
(Separate Book)



ANNEXURE-D

DVD of RAW Data & Site Pictures



