

PEDESTRIAN ROAD CROSSING BEHAVIOR AT SIGNALISED INTERSECTIONS AND MID BLOCK SECTIONS IN DHAKA CITY

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It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any degree or diploma.

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Hasinae-Jannat

This thesis is dedicated to my parents and my son Md.Zarraf Wasi. Their continuous inspirations made this effort possible.

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List of Abbreviations

BIRDEM= Bangladesh Institute of Research and Rehabilitation in Diabetes, Endocrine and Metabolic Disorders

BSMMU= Bangabandhu Sheikh Mujib Medical University

DAP= Detailed Area Plan

DU= Dhaka University

DCC=Dhaka city Corporation

DMDP = Dhaka Metropolitan Development Plan

EPP= Exclusive Pedestrian Phase

GIS = Geographical Information System

HCM = Highway Capacity Manual

ICU= Intersection Capacity Utilization

MUTCD= Manual of Uniform Traffic Control Devices

PCU = Passenger Car Unit for car

PPP= Public-Private Partnership

RAJUK= Rajdhani Unnayan Katripakhya

RHD = Roads and Highway Department

STP= Strategic Transport Plan

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ABSTRACT

Dhaka is one the most densely populated cities of the world. Here huge pedestrian gather in roads and intersections. At presents pedestrian crossing is one of the greatest challenges for the traffic and safety engineering communities. Present study deals with pedestrian crossing behavior at signalized intersections and mid block sections in Dhaka city. To carry out the analysis at first number of intersections were collected from DCC and then survey were conducted to find out the existing pedestrian crossing facilities at near about 70 signalized intersections in Dhaka city. The study reveals that in Dhaka city area the generalized situation of pedestrian facilities are very poor. It signifies that about 70% intersections have no visible cross marking and about 73% intersections have no foot over bridges and underpasses.

Six important intersections were selected to count the amount of pedestrian crossing at peak period namely Shahbag, Banglamotor, Sonargaon, Maghbazar, Elephant road and Newmarket intersection. In this survey, direction wise amount of pedestrian crossing, number of pedestrian crossing with foot over bridge and number of legal and illegal crossing were collected. Pedestrian crossing behaviors were also observed at 6 selected intersections namely Shahbag, Banglamotor, Sonargaon, Maghbazar, Elephant road and New market. Pedestrian crossing rate at these intersections is about 5000 to 7000 per hour at peak period and average 15% to 25% illegal crossing occurs at those intersections. Categorized Pedestrian crossing behaviors are collected from video record survey for three intersections namely Shahbag, Sonargaon and Newmarket which are different from different intersections. From the study it is observed that pedestrians are not willing to use grade separated crossing because it is time consuming and it consists physical labour. For doing this type of crossing they can take risky crossing. But in some intersections at grade crossing becomes very risky because of its high traffic volume and high vehicle speed. But pedestrians always prefer at grade crossing for this reason at grade pedestrian crossing facilities should be improved by different type of latest technologies.

One of the latest pedestrian crossing technologies is exclusive pedestrian phase (EPP) or pedestrian scramble at signalized intersections in Dhaka city where possible. Pedestrian scramble signal has potential to reduce pedestrian-vehicle conflicts at urban signalized intersections with high volumes of vehicular and pedestrian traffic. In this study three signalized intersections were selected to incorporate exclusive pedestrian phase and evaluate it by delay parameter. The selected intersections are Newmarket, Shahbag and Sonargaon intersections of Dhaka City. It is based on the assumptions that if there is no pedestrians in the intersection during the vehicular signal phase, vehicular traffic would flow more smoothly. Introducing EPP in this study is based on the hypothesis that an additional pedestrian phase has a positive correlation to increase efficiency of the intersection.

CHAPTER: ONE

INTRODUCTION

1.1 Background

A pedestrian is a person traveling on foot, whether walking or running. Pedestrian may be defined as those human traffic who are supposed to walk as a part of their movement and to use those facilities such as foot path, overpass, zebra crossing, subway etc at any stage of their travel in order to accomplish their activities with which they are engaged in. Pedestrian activity is a major component in urban street capacity analysis and pedestrian characteristics are an important factor in the design and operation of transportation systems. An intersection is defined as an at-grade crossing of two or more roadways. Intersections are the most busy places in the road way. Pedestrian movement as well as pedestrian crossing at intersection is very important thing for the pedestrian safety and intersection capacity analysis. At busy intersections motorists, cyclists, and pedestrians often have to deal with complex situations and be aware of the position, movement and intent of other users. Mixed traffic of motor vehicles and pedestrians are common in urban intersections. Efficiency of intersections greatly affects the entire network performance.

A pedestrian crossing or crosswalk is a designated point on a road at which some means are employed to assist pedestrians wishing to cross. They are designed to keep pedestrians together where they can be seen by motorists, and where they can cross most safely with the flow of vehicular traffic. Some times for improving pedestrian safety and intersection capacity, pedestrians are segregated from the way of motor vehicles by overpasses and underpasses. But Pedestrian chooses the shortest route for crossing the roadway and they want to minimize travel time. Pedestrian also have a basic resistance to change grades when crossing the roadways. They do not voluntarily make use of special pedestrian facilities such as overpasses and underpasses. In Dhaka city most of the pedestrian may take risk in crossing the road and they often cross at mid-block instead of using crosswalk.

In this circumstance, such a study regarding Pedestrian Road Crossing Behavior at Signalized Intersections and Mid Block Sections in Dhaka City will reveal analysis on pedestrian road crossing behavior which will be helpful for future policy formulation regarding efficiency and safety improvement of the intersections.

1.2 Objectives of the Study and possible Outcome

This study has been aimed at achieving the following objectives:

1. To study the pedestrian crossing facilities at intersections in Dhaka City
2. To study pedestrian movement pattern at some selected intersections and foot over bridges in Dhaka City
3. To identify the problems associated with pedestrian crossing at intersection
4. To evaluate the necessity of exclusive pedestrian phase at signalized intersection.

This study is expected to have some findings about incorporation of pedestrian phasing in signal design process. This study will reveal problems and prospects of pedestrian movement pattern at intersections and foot over bridge of Dhaka City. It will make a clear clarification how to incorporate pedestrian issues in traffic engineering and transport management. In the long run this study will formulate policy guidelines how to incorporate pedestrian issues in future transportation planning and decision making.

1.3 Rationale of the Study

Dhaka is the administrative, commercial and cultural capital of Bangladesh which serves as the nerve center of the country. It is one of the 10 mega cities in the world. Growing at a very fast rate, Dhaka's urban Population is predicted to increase from 11.3 million to about 21 million by 2015. With the growing importance of the city and mounting up pressure of population, traffic congestion is getting more and more precarious every year.

Pedestrian poses a significant position in traffic generation and increasing day by day in Dhaka. Most of the trips are started and ended as the means of a pedestrian. Dhaka is one of the fastest growing cities of the world. The city lacks proper transportation planning. Dhaka integrated transport study estimated 66% of all work trips are on foot. But

unfortunately pedestrian facilities are poorly managed in Dhaka City. Walking is a commonly used mode of transport in Dhaka. The proportion of trips made by walking is increasing day by day. Existing pedestrian infrastructure and pedestrian facilities are not satisfactory. There is no pedestrian crossing phase at signalized intersection. There exist only 320.44 kilometers of footpaths in Dhaka City Corporation Area which belong to 155 acres of land. Average width of the footpaths is 1.96 meter. But unfortunately most of them are not used properly. Hence, pedestrian movement at the intersection should be one of the major concerns to traffic engineers. Successful planning and design of pedestrian facility largely depends upon the better understanding the pedestrian crossing behavior and effective enforcement measures. A few studies have been so far conducted regarding pedestrian facilities. Md. Abdul Wareh (1991) pointed out in his thesis “Effect of Pedestrian Underpasses on Traffic Flow Characteristics: Metropolitan Dhaka” pedestrian crossing behavior in particular relation to the grade separated pedestrian facilities. He also assessed the effect of underpasses on traffic flow characteristics Hamed (2000) studied the factors that influence a pedestrian’s waiting time and frequency of attempts to cross the street.

Md. Hadiuzzaman (2008) pointed out in his thesis “Development of Saturation Flow and Delay Models for Signalized Intersection in Dhaka City” provided standard terminology, saturation model which has been studied to acquire secondary information. But none of the studies were conducted on how to consider the exclusive pedestrian phasing in regard to Dhaka city. In this circumstances, such a study encompassing pedestrian crossing behavior at intersections and mid blocks

1.4 Outline of Methodology:

Methodology describes the procedures that have been followed to operationalize the research design for the collection and analysis of the information and data in confirmation with the research. Data from both primary and secondary sources has been used for this study. This study also maintains the following methodology for the achievement and successful accomplishment of the dissertation work.

Field survey has been conducted to identify the existing pedestrian crossing facilities are present at major intersection in Dhaka city. Existing pedestrian crossing facilities has been collected manually. Pedestrian movement data has been collected by manual and video recording method of some selected intersections where traffic demand and pedestrian activities are very high. Direction wise pedestrian crossing data has been collected at evening peak period. Data analysis has been performed by MS Excel.

Pedestrian behavior studies have been done by manual observation and video recording survey. From this observation problems associated with pedestrian crossing at intersections has been identified.

Some signalized intersections has been selected to introduce exclusive pedestrian phase which are very busy and in which pedestrian activities are very high. The video recording survey has been performed to collect the traffic volume data and from those data signal design has been performed considering exclusive pedestrian phase and delay analysis has been performed by renowned Webster method.

1.5 Organization of the Thesis

The thesis consists of six chapters including the present one. The first chapter deals with the introduction, problem statement, objectives and methodology. Chapter two presents literature review and introduce deferent type of pedestrian crossing and traffic flow characteristic at signalized intersections. Chapter three gives the methodology and data collection technique of the study. Chapter four describes the existing situation of the pedestrian crossing facilities at the intersections of Dhaka city, intersections selection and data collection technique. Pedestrian crossing analysis at six selected intersection and problems associated with pedestrian crossing are presented in this chapter. This chapter also starts with the discussion of the study area and then gives details about selected intersections. Chapter five contains introducing and evaluation of exclusive pedestrian phase (EPP). Summary, conclusions, recommendation, limitations and future scope are presented in chapter six.

CHAPTER: TWO

LITERATURE REVIEW AND TERMINOLOGY

2.1 Literature review

Few studies have so far been conducted in Bangladesh regarding pedestrians. These studies are mainly focused on overview of the generalized problems related with pedestrians. But none of them has measured the state of pedestrians at intersections. To have better understanding on the conceptualization on the issue, information related to the research were collected from different available existing books/journals, unpublished thesis, seminar paper, magazine, newspapers etc. The study also used recommendations of different study reports related with the research. It was useful to collect opinions of different researchers in this matter. Some literatures on the issue are as follows:

The Highway Capacity Manual, TRB, National Research Council, Washington, D.C. focused on different Pedestrian capacity terminology, principles of pedestrian flow, pedestrian speed-density relationships, level of service which were studied for conceptual development on this issue.

Md. Abdul Wares (2001) pointed out in his thesis “Effect of Pedestrian Underpasses on Traffic Flow Characteristics: Metropolitan Dhaka” pedestrian crossing behavior in particular relation to the grade separated pedestrian facilities. He also assessed the effect of underpasses on traffic flow characteristics.

Chowdhury et al (2010) in thesis “A study on Pedestrian Walking Speed” provided of pedestrian crossing speed in different locations of Dhaka city. They observed pedestrian walking speed between different road facilities like zebra crossing, signal compliance, road mid-section and roadside footpath.

Mannering Fred L et.al (2005) in his book “Principles of Highway Engineering and Traffic Analysis” provided guidelines on Intersection and signal control characteristics,

analysis of traffic at signalized intersection, signalized intersection analysis for level of service, traffic signal phasing and timing plan which are relevant to get information to conduct this study.

Md. Hadiuzzaman (2008) pointed out in his thesis “Development of Saturation Flow and Delay Models for Signalized Intersection in Dhaka City” provided standard terminology, saturation model which has been studied to acquire secondary information. He also calculated delay following HCM 2000 delay model which was used as secondary information. He developed saturation flow model and delay model for some selected intersection of Dhaka city which was used as secondary information.

Ganesh J Karkee (2009) in his paper “Statistical Analysis of Pedestrian Crossing Behavior on Streets” suggested that several factors influence a pedestrian’s decision to use or not to use a crosswalk to cross a street. The presence of a crosswalk and its proximity to the pedestrian’s trip origin or destination, and traffic volume on the street, play a key role in this decision making process.

JP Pitaksringkarn (2005) in his paper “Implementation of the First Pedestrian Scramble in Downtown San Diego, California” published in the Journal of the Eastern Asia Society for Transportation Studies, Vol. 5, pp. 2504-2515 suggested that the result from the Synchro traffic signal analysis is that the proposed pedestrian scramble signal has no significant impact to the current vehicular traffic operation at the intersection which inspired the study to introduce EPP in Dhaka city.

Xu Hao et al (2005) in paper “ Pedestrian Crossing Behavior At Signalised Crossings” published in the Journal of Association for European Transport and contributors suggested in order to identify junctions where priority should be shifted to pedestrians it is necessary to understand the crossing behavior of pedestrians and their perceptions of different crossing types.

Bijan Vaziri (1996) in his paper “ Exclusive Pedestrian Phase for the Business District Signals in Beverly Hills, 10 Years Later: City of Beverly Hills, California, 1996” published in the Journal of City of Beverly Hills Engineering Department 455 N. Rexford showed that the addition of an exclusive pedestrian signal phase to the signal timing considering to clear the intersection of pedestrians during the vehicular phase, allows better movement of vehicles and permitting pedestrians to cross without vehicle interference. This also improves the safety of pedestrians and reduces the potential for auto/pedestrian conflicts and accidents.

Bissessar, R. et al (2010) in paper “Pedestrian Scramble Crossings – A Tale of Two Cities” presented analysis on public response after introduction of pedestrian scramble phase in Toronto. They mentioned that a survey was conducted on 462 pedestrians three months later over a two-day period at the Yonge Street/Dundas Street intersection to assess their reaction to the pedestrian scramble operations. Results from the survey show 89% of pedestrians thought it was a good idea to have this type of operation at the Yonge Street/Dundas Street intersection. When asked what the purpose of the walking trip was, 32% of the pedestrians surveyed indicated that they were travelling to/from work and 31% were travelling to/from school. 57% of the pedestrians surveyed indicated that they cross this intersection more than once a day. 78% indicated that they have crossed this intersection diagonally.

2.2 Standard Terminology

The following terms are commonly used to pedestrian crossing .

Types of Cross walk

There are currently five types of formal pedestrian crossings used in the United Kingdom, these being Zebra, Pelican, Puffin, Toucan and Pegasus crossings. The most basic form of crossing is a pedestrian refuge; this is usually in the form of an island in the centre of the road.

Zebra Crossings

This is characterized by wide longitudinal stripes on road, often with belisha beacons; pedestrians may cross at any time; drivers must give way to pedestrians who demonstrate intent to cross. It is also marked by black and white painted strips across the road and flashing amber beacons. The Highway Code says that motorists 'MUST give way when someone has moved onto a crossing'. However, pedestrians should remain on the kerbside for safety's sake until approaching vehicles have stopped. Zebra crossings are cheaper to build than traffic signal crossings although their use on roads where traffic speeds are higher than 35mph is not recommended.

Refuge Island

It is also known as a pedestrian refuge or pedestrian island, is a small section of pavement or sidewalk, completely surrounded by asphalt or other road materials, where pedestrians can stop before finishing crossing a road. It is typically used when a street is very wide, as the pedestrian crossing can be too long for some individuals to cross in one traffic light cycle.

Pedestrian Crossing Facilities at Signalized Intersections

All traffic signals will be installed in accordance with the relevant Standards Australia and Austroads guidelines are given below

Prioritizing Of Intersection Upgrades

Designation of priority for installing symbolic pedestrian displays and audible tactile facilities at existing signalized intersections will include, so far as reasonably practical, consideration of Pedestrian demand the requirements of key stakeholders including blind and vision impaired stakeholders. Opportunities to minimize installation costs by combining installations with other Upgrades/modifications at sites.

Parallel Pedestrian Crossing Which Vehicles May Cross For the Full Pedestrian Crossing Period

Pedestrian signals will generally be configured to allow pedestrians to cross in parallel with traffic, with vehicles required to give way to pedestrians, when turning left or right across their path.

Parallel Pedestrian Crossing Which Vehicles May Cross After an Initial Period

Pedestrian signals may be configured to prevent motor vehicles crossing the path of pedestrians for an initial period, less than the full crossing time. This will be provided at guidelines on pedestrian crossing facilities a signalis.doc main roads were all newly installed parallel pedestrian signal crossings for a period of 1 year, after which they will be considered by manager metropolitan traffic operations for reconfiguration to provide a parallel pedestrian crossing which vehicles may cross for the full pedestrian crossing period. Locations where driver behavior is considered by manager metropolitan traffic operations to be unsafe for a parallel pedestrian crossing which vehicles may cross for the full pedestrian crossing period.

Parallel Pedestrian Crossings Which Prevent Vehicles Crossing for the Pedestrian Crossing Period

Pedestrian signals may be configured to prevent motor vehicles crossing the path of pedestrians for the entire pedestrian crossing period when any one or more of the following criteria is met:

- The sight distance between motorists and pedestrians is less than the stopping distance for typical vehicle speeds near the intersection.
- Double left or right turns are permitted across pedestrian movements
- There is significant use by children, the elderly or people with disabilities
- The volume of heavy vehicles turning across the pedestrian crossing exceeds 50 vehicles per hour for each of the same 4 hours of a normal weekday.
- The speed limit exceeds 60 kph

Exclusive Pedestrian Phase Crossings

Pedestrian signals may be configured to provide an exclusive pedestrian phase whereby all vehicle movements in all directions across the intersection are stopped and pedestrians are allowed to cross in all designated directions, when all of the following criteria are met:

- None of the roads is a declared highway or main road
- The intersection is in a central business area or shopping area
- An equivalent or better alternative route is available for through traffic to avoid the intersection if it so desires
- The existing signal intersection is operating in a simple 2 traffic phase mode
- During any 4 periods (consecutive or non-consecutive) of 1 hour each, on any weekday, more than 200 pedestrians cross in all directions per hour and during the same hours, more than 400 vehicles turn within the intersection.

Signalized intersection

Cycle: One complete sequence of signal indications

Cycle length (C): Total time for the signal to complete one cycle, generally expressed in second.

Phase: Part of cycle allocated to any combination of traffic movements receiving the right of way simultaneously during one or more interval.

Intersection: An intersection is defined as an at grade crossing of two or more roadways.

Interval: Period of time during which all signal indications remain constant

Change interval (Y): The "yellow" and/or "all-red" intervals, which occur at the end of a phase to provide for clearance of the intersection before conflicting movement are released also known as "Amber Period".

Footbridge: A footbridge or pedestrian bridge is a bridge designed for pedestrians to provide safe and sustainable crossings. In many developed countries, footbridges are both functional and can be beautiful works of art and sculpture. Types of footbridge include Simple suspension bridge, clapper bridge, moon bridge, step-stone bridge, zig-zag bridge. Types of residential-scale footbridges include plank, boardwalk, joisted, simple-truss. Different types of design footbridges include timber footbridges, steel footbridges,

concrete footbridges. Complicated engineering is not needed and the footbridges are built with readily available materials and basic tools.

Green time (G): Time within a given phase during which the "green" indication is shown, stated in seconds.

Lost time: Time during which the intersection is not effectively used by any movement, which occur during the change and clearance intervals (when the intersection is cleared) and at the beginning of each phase as the first few vehicles in a standing queue and experience start-up delays.

Effective green time (g): Time during which a given phase is effectively available for stable moving platoons of vehicles in the permitted movements, generally taken to be the green time plus the change and clearance interval minus the lost time for the designated movement, stated in seconds.

Green ratio (g/C): Ratio of effective green time to the cycle length

Effective red (r): Time during which a given movement or set of movements is effectively not permitted to occur, the cycle length minus the effective green time, stated in seconds.

Mid-blocks: A Mid-block may be narrowly seen as the roadway section between two consecutive intersections, regardless of whether they are signalized or not. This view is in line with the traditional definition of a street block. Alternatively, a block may be broadly seen as the roadway section between two consecutive signalized intersections.

Actual Flow Rate: The design flow rate, or the maximum flow that is expected to use the intersection. See the theory and concepts modules on peak hour volume, design flow rate, and PHF.

All-red interval: Any portion of a signal cycle in which a red indication is observed by all approaches.

Approach: The portion of an intersection leg that is used by traffic approaching the intersection.

Capacity: The maximum number of vehicles that can reasonably be expected to pass over a given roadway or section of roadway, in one direction, during a given time period and under the prevailing roadway, traffic, and signalization conditions.

Change interval: Identical to the intergreen interval.

Clearance interval: Identical to the all-red interval.

Critical Flow Ratio: The flow ratio of the critical lane group within a phase. The actual or design flow rate for the critical movement divided by the saturation flow rate for that movement.

Critical Movement or Lane: The lane or movement for each phase, depending on how you choose to subdivide your intersection, that requires the most green time.

Critical Volume: A volume, or combination of volumes, which produces the greatest utilization of capacity for the street or lane in question, given in terms of passenger car units per hour per lane or mixed vehicles per hour per lane.

Cycle: A complete sequence of signal indications. Each phase has been serviced and the cycle is beginning again.

Cycle Length: The time required for one full cycle of signal indications, given in seconds.

Delay: The stopped time per vehicle (in seconds per vehicle), usually calculated separately for each lane group.

Design Flow Rate: Identical to the actual flow rate.

Effective Green Time: The green time that is actually used by traffic. Some lost time occurs initially while traffic responds to the green signal and begins to accelerate. Some time is also lost during the intergreen period as vehicles stop in anticipation of the next phase.

Flow Rate: The rate, in vehicles per hour or passenger car units per hour, at which traffic is entering an intersection.

Flow Ratio: The ratio of the actual flow rate to the saturation flow rate.

Green Interval: The portion of a signal phase in which the green signal is illuminated.

Green Ratio: The ratio of the effective green time to the cycle length.

Green Time: The length of the green interval and its change interval, given in seconds.

Hourly Volume: The number of mixed vehicles that traverse a given section of lane or roadway during an hour.

Intergreen: The time interval between the end of a green indication for one phase and the beginning of green for the next phase.

Intersection Flow Ratio: The sum of all the critical flow ratios one from each phase.

Lane Group: Any group of lanes. Lanes can be combined during the signal timing design process in order to simplify the calculations.

Legs (intersection): The portions of the intersecting streets or roadways that are within close proximity to the actual intersection.

Level of Service (LOS): A measure of the operating conditions of an intersection.

Lost Time: The time during a given phase in which traffic could be discharging through the intersection, but is not. This is the period during the green interval and change intervals that is not used by discharging traffic.

Passenger Car Units: A unit of measure whereby large trucks and turning movements are converted to passenger cars using multiplication factors. This allows you to deal with mixed traffic streams more accurately than if you had assumed all vehicles were created equal.

Peak-Hour: The hour of the day that observes the largest utilization of capacity, or the hour of the day in which the largest number of vehicles use the intersection approach or lane of interest.

Peak-Hour Factor: The ratio of the number of vehicles entering an approach during the peak hour to four times the number of vehicles entering during the peak 15 minute period. In the absence of field information, a value of 0.85 is normally used.

Pedestrian Crossing Time: The time that is required for a pedestrian to cross the intersection.

Phase: The portion of the cycle that is devoted to servicing a given traffic movement.

Phase Sequence: The predetermined order in which the phases of a cycle occur.

Queue: A closely spaced collection of vehicles.

Roadway Conditions: The physical aspects of the roadway, such as lane-width, number of lanes, easements, bike lanes, shoulder width, and any other aspect of the roadway.

Saturation Flow Rate: The maximum number of vehicles from a lane group that would pass through the intersection in one hour under the prevailing traffic and roadway conditions if the lane group was given a continuous green signal for that hour. This assumes that there is a continuous queue of vehicles with minimal headways.

Signalization Conditions: All the various aspects of the signal system, including timing, phasing, actuation, and so on.

Split: A percentage of a cycle length allocated to each of the various phases in a signal cycle.

Traffic Conditions: The qualities of traffic, such as traffic speed, density, vehicle types, and traffic flow rate.

CHAPTER: THREE

METHODOLOGY AND STUDY DATA

3. Outline of Methodology:

Methodology describes the procedures that have been followed to operationalize the research design for the collection and analysis of the information and data in confirmation with the research. Data from both primary and secondary sources has been used for this study. This study also maintains the following methodology for the achievement and successful accomplishment of the dissertation work.

Field survey has been conducted to identify the existing pedestrian crossing facilities are present at major intersection in Dhaka city. Existing pedestrian crossing facilities has been collected manually.

Pedestrian movement data has been collected by manual and video recording method of some selected intersections where traffic demand and pedestrian activities are very high. Direction wise pedestrian crossing data has been collected at evening peak period. Data analysis has been performed by MS Excel.

Pedestrian behavior studies have been done by manual observation and video recording survey. From this observation problems associated with pedestrian crossing at intersections has been identified.

Some signalized intersections have been selected to introduce exclusive pedestrian phase which are very busy and in which pedestrian activities are very high. Introducing EPP in this study is based on the hypothesis as an additional pedestrian phase has a positive correlation to increase efficiency of intersection. In other words, if a pedestrian phase is introduced it will lead to increase vehicle speed. To examine the hypothesis, traffic speed of different types of vehicles were determined through video recording in three selected intersections. Road width was calculated from GIS database prepared by RAJUK in Detailed Area Plan (DAP).

The video recording survey has also been performed to collect the traffic volume data which was necessary for signal design considering exclusive pedestrian phase and delay analysis has been performed by renowned Webster method.

3.1 Data Collection

Both primary and secondary sources of data have been used by the study. But as the study of pedestrian situation in the study area is comparatively a new one, the study mostly depended on primary sources for data and information.

3.1.1 Primary Data Collection

Manual and video recording methods of data collection have been applied in this study. Information has been collected about the basic parameters considered by the study. There are more than 70 signalized intersections in Dhaka city. But near about 70 signalized intersections were surveyed for lack of timing to identify the existing pedestrian crossing facilities. Some important unsignalized intersections were surveyed for the same cause which is controlled by traffic police. Pedestrian facilities in 70 intersections have been manually surveyed to know the generalized situation of the intersections of Dhaka city. The names of more than 70 intersections were collected from Dhaka City Corporation. As the population of Dhaka city is very high huge pedestrian gather in most of the intersections of Dhaka city. For the lack of timing it could not possible to count pedestrian crossing behavior at every signalized intersections of Dhaka city.

Six important intersections were selected to count the amount of crossing at peak period 5p.m to 6p.m. namely Shahbag, Banglamotor, Sonargaon, Mogbazar, elephant road and newmarket intersection. Although they are signalized intersections but most of them are not operated by traffic signal timing at peak period, they are only operated by traffic signal timing by off peak period and in peak period they are operated by one or more traffic police. In these survey direction wise amount of pedestrian crossing, number of pedestrian crossing with foot over bridge and number of legal and illegal crossing were surveyed. Here legal crossing means crossing with signal and grade separated crossing and illegal crossing means crossing without signal and risky crossing. Pedestrian

crossing behavior were also observed at 6 selected intersections namely Shahbag, Banglamotor, Sonargaon, Mogbazar, elephant road and new market which consist of pedestrian traffic's age, education and destination.

One hour Traffic Volume Survey were conducted by Video recording in 3 selected intersections at morning peak period from 8a.m. to 9p.m and evening peak period from 5 p.m to 6 p.m for the necessity of achieving the objective of considering exclusive pedestrian phasing. At New market intersection morning peak hour were taken 9.30a.m to 10.30a.m because it is shopping areas which begin their activities after 9a.m. Applicability of introducing Exclusive pedestrian Phase (EPP) was studied in three intersections as Shahbag, Sonargaon, and Newmarket intersections.

Study Area: Six Important Intersections of Dhaka City

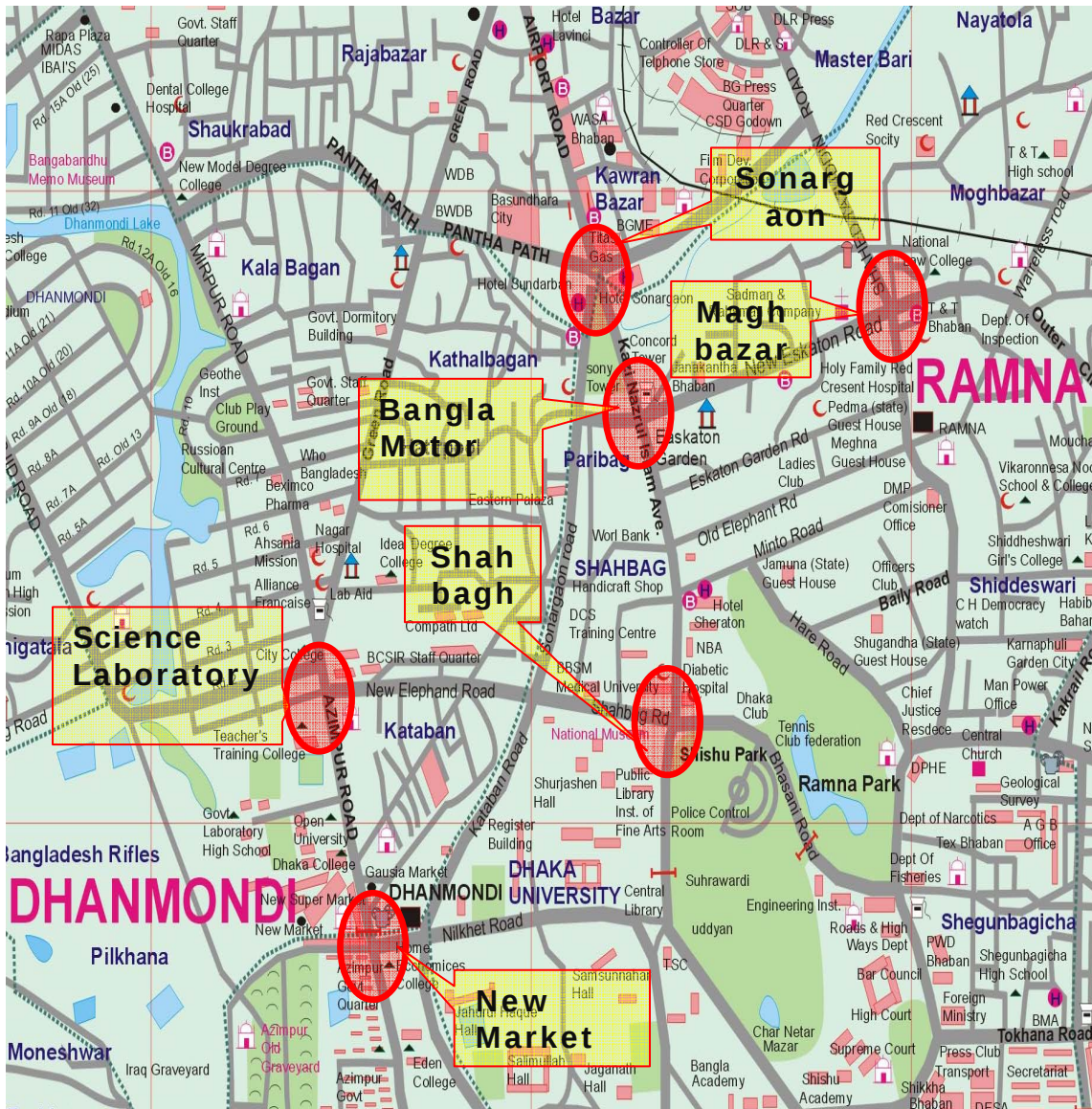


Fig: 3.1 Six Important Signalized Intersection of Dhaka City

3.1.2 Secondary data collection

Secondary data has been collected from different sources as previous thesis, journals, books and internet. The maps of the study area, related plans, rules and regulations, etc were collected from secondary sources.

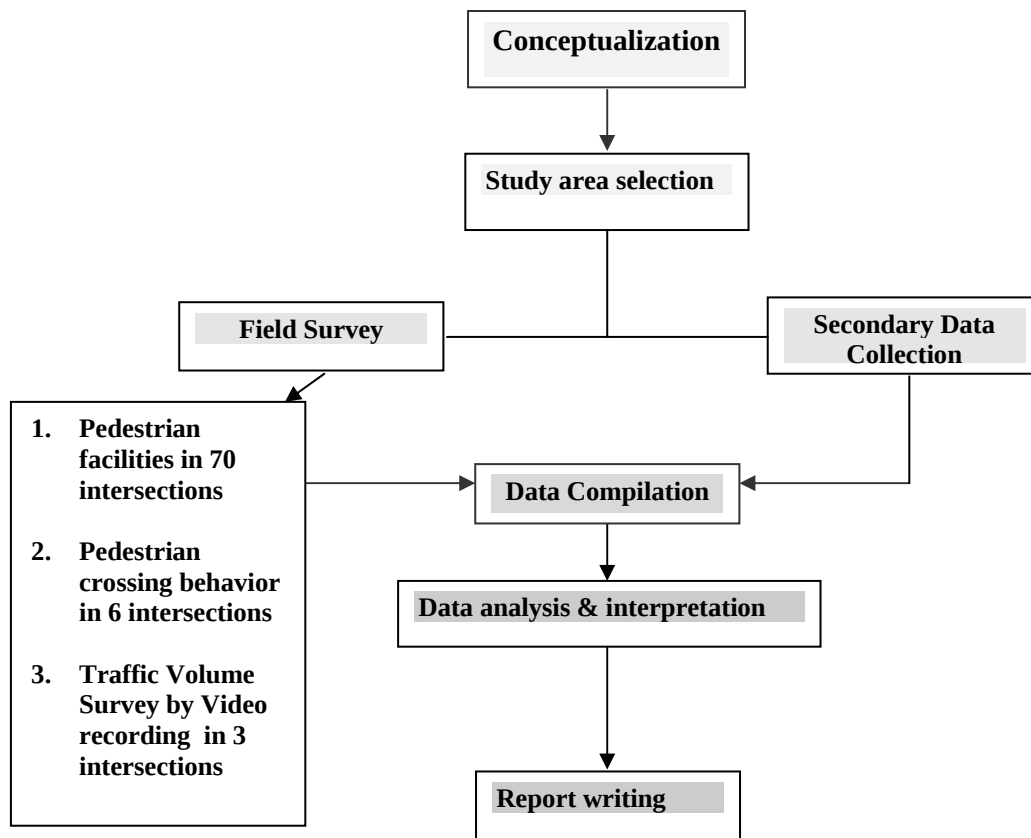


Fig: 3.2 Flow diagram of methodology

3.2 Data Processing

Raw data has been processed for data analysis. The data were processed according to their use for the fulfillment of objectives. Data are processed through statistical package software's spreadsheets and through map locations.

3.3 Data Analysis and Presentation

Processed data has been analyzed in the possible simple format. The analysis is statistical and calculative as far as possible for the purpose of the study. The computer software that are used in data processing and analysis are –Microsoft Office XP, Auto CAD 2004 which are used for graphical analysis and presentation in different format. The presentation of report is as possible as brief and in explanatory format. In this connection, the necessary software is the Microsoft Word (Version - Office XP) as well as the above.

CHAPTER: FOUR

PEDESTRIAN CROSSING BEHAVIOR

4.1 Introduction

Pedestrian may be defined as those human traffic who are supposed to walk as a part of his movement and to use the facilities such as foot over bridge, zebra crossing, underpass, footpath etc at any stage of their travel in order to accomplish their activities. All road users are pedestrians at some stage of each journey and some are pedestrians the whole time (Wares, 2001).

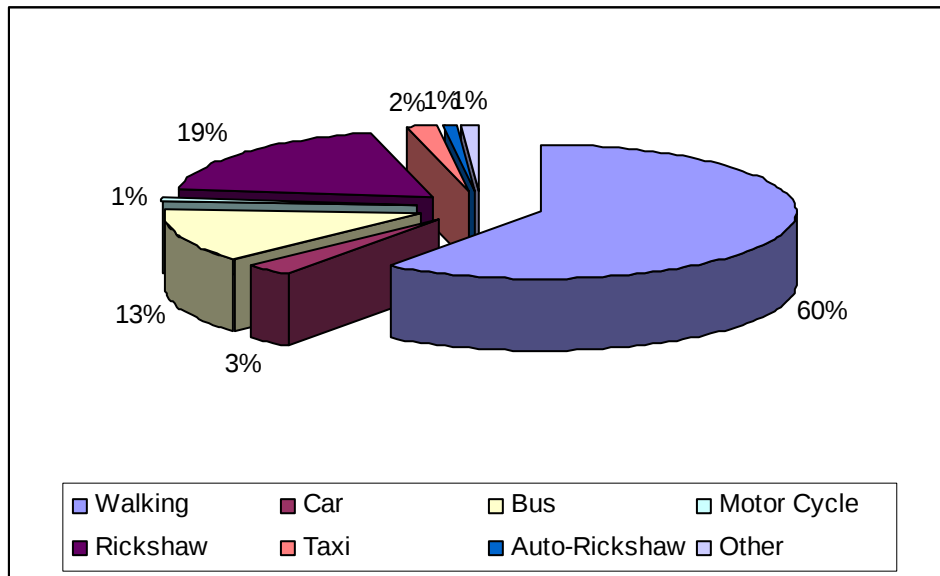
Pedestrian crossing behavior depends on individual socio-demographic factors such as gender and age; environmental factors such as land use, street design, and facilities such as pedestrian overpasses and underpasses; traffic conditions such as heavy, high-speed traffic; enforcement factors; and factors related to education and policy (Mehndiratta, S. et al 2010). The movement of people and goods are linked with distribution and intensity of land use. People do not of course move on the roads for nothing. People move because of activities with which they are engaged in. As such pedestrian is, therefore function of activities. Pedestrians issue is important especially in urban areas where intense land use cause concentrated activities.

They are the most difficult transport group to control and hard to enforce. The pedestrians are more often disobey the traffic control devices than are drivers. Their actions are less predictable than those of drivers, as many pedestrians consider themselves “outside the law” in traffic matters.

4.2 Pedestrian as one of the dominant Mode of Transport

There is a wide variety of transport modes available in Dhaka city. Walking is a commonly used mode of transport in Dhaka. The proportion of trips made by walking is substantial and for some people, walking is a matter of choice and convenience. However, the reality is that for many people, walking is a matter of economic necessity (STP, 2005). Beside the pedestrians, other means of travel are bicycle, rickshaw,

motorcycle, baby-taxi, tempo, minibus, bus, car, taxi, jeep etc. Fig: 4.1 shows about 60% mode of transport is walking.



Source: (Rahman, 2003)

Fig: 4.1 Percentage of different Modal Vehicles of Dhaka City 2003

Although walking mode is high, most of cases pedestrian do not get proper facilities to cross the road .The Fig: 4.2 shows the pedestrian crossing is difficult in a mixed mode zone.



Fig: 4.2 Crossing in a mixed mode

Despite a high preponderance of walking, suitable pedestrian facilities have been neglected and have, in most cases, only been added as an afterthought to road improvements. It has been estimated that there are only about 400 kilometers of footpath within the DCC area. Where footpaths have been built, there are frequent obstructions that block or otherwise reduce their overall usefulness. Such obstructions include: -

- Temporary vender stations and hawkers who occupy portions of the footpaths;
- Parked cars;
- Solid Waste skips;
- Building materials and debris that are stored or abandoned on the footpath; and
- Holes, surface irregularities and water accumulation.

The following Fig: 4.3 shows waste dumping in the footpath which is force to pedestrian walking in the roads.



Fig: 4.3 Waste Dumping on the footpath

Pedestrian of Dhaka city confiscated with physical, infrastructural human made non compliances. As the urban infrastructures are not pre-planned pedestrian facilities are



Fig: 4.4 Poor and Dilapidated footpaths and roads

poorly devised in Dhaka. Water logging is a very common scenario which is a great obstacle for planning of pedestrian facilities. The Fig: 4.4 and Fig: 4.5 shows water logging is a great threat for pedestrian.



Fig: 4.5 Water Logging is a threat for pedestrians

Pedestrians face severe congestion as foot path are occupied by street vendors locally named as ‘ferrywallas’. According to certain estimates, nearly 40% percent of the footpaths are being occupied illegally (STP, 2005). Fig: 4.6 and Fig: 4.7 shows that the footpaths are illegally occupied by vendors which is also threat for pedestrian.



Fig: 4.6 Footpaths are occupied by vendors



Fig: 4.7 Footpaths are occupied by vendors in Shahbag

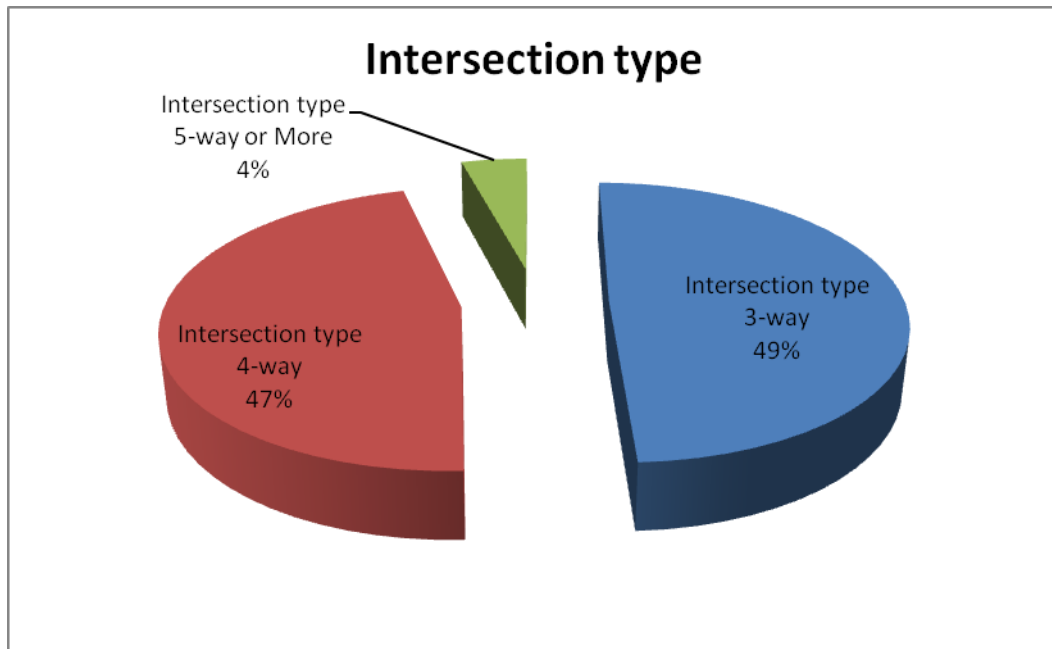
In spite of a High Court ruling on February 11, 2001, ordering that the responsible agencies make all footpaths free from illegal occupation, no significant change or improvement is evident. As a consequence, pedestrians are often forced to walk in the street instead of on the footpaths, even in areas where footpaths are provided. Pedestrians walking on the road increase the risk of traffic-related pedestrian injuries and also have the adverse effect of the reducing the capacity of the road and thereby increasing congestion. Available information indicates that pedestrians are involved in half of all road collisions in the city. Two-thirds of all traffic related fatalities are pedestrians. According to STP survey, pedestrian volumes of 10,000 to 20,000 per day are common and reach as high as 30,000 to 50,000 per day in the Old City area. During the peak hour pedestrian counts of 1,000 to 3,000 per hour are common and reach as high as 5,000 in the Old City area.

4.3 Category of Intersections in Dhaka City

In order to identify junctions where priority should be shifted to pedestrians it is necessary to understand the crossing behavior of pedestrians and their perceptions of different crossing types (Hao, Xu et al 2005). Manual and video recording methods of data collection have been applied in this study. Information has been collected about the basic parameters considered by the study. Pedestrian facilities in 70 intersections have been manually surveyed to know the generalized situation of the intersections of Dhaka city. The name of the 70 intersections was collected from Dhaka City Corporation.

In the field of road transport, an intersection is a road junction where two or more roads either meet or cross at grade (they are at the same level). Such a road junction may also be called a crossroads. Some may classify intersections as 3-way, 4-way, 5-way, 6-way, 7-way etc. depending on the number of road segments (arms) that come together at the intersection. A junction between three road segments (arms) is a T junction (two arms form one road) or a Y-junction. 4-way intersections are the most common, because they usually involve a crossing over of two streets or roads. 5-way, 6-way and multiple intersections are less common but still exist, especially in urban areas with non-rectangular blocks. In Dhaka city area the study reveals that about a half of the

intersections nearly 49% are T-type and Y-type, followed by 47% as 4-way intersection and the rest 4% are 5-way and more road junctions which is shown in Fig:4.8.



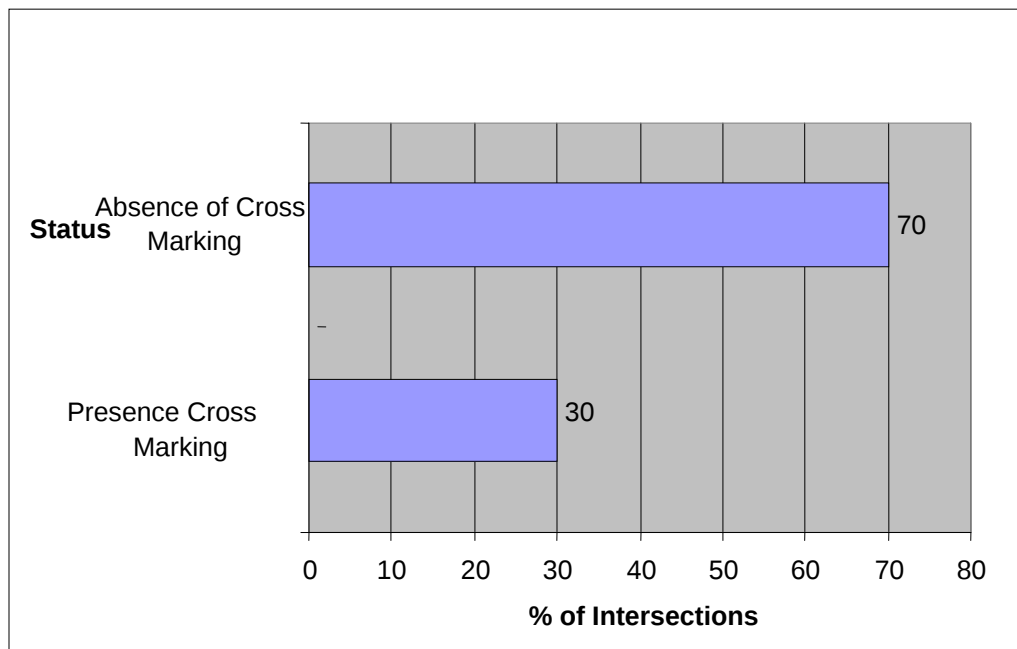
Source: Field Survey 2011

Fig: 4.8 Different types of Intersections in Dhaka City

4.4 Existing Pedestrian Facilities

4.4.1 Presence of Cross Marking

A pedestrian crossing or crosswalk is a designated point on a road at which some means are employed to assist pedestrians wishing to cross. They are designed to keep pedestrians together where they can be seen by motorists, and where they can cross most safely across the flow of vehicular traffic. Pedestrian crossings are found at intersections, and also be at other points on busy roads .They are generally also installed common where large numbers of pedestrians are attempting to cross (such as in shopping areas) or where vulnerable road users (such as school children) regularly cross etc. In Dhaka city area the study reveals that about 70% intersections have no cross marking and cross marking are present about 30% intersections which is shown in Fig: 4.9.



Source: Field Survey 2011

Fig: 4.9 Percentage of intersections having Cross mark

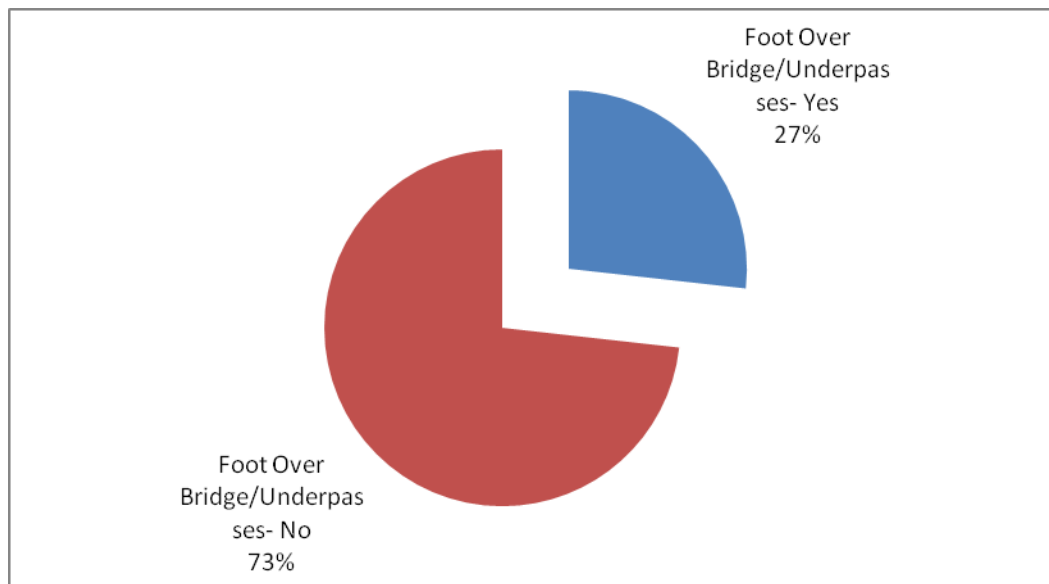
In Dhaka city most of the signalized intersections has no cross marking. The following Fig: 4.10 shows a signalized intersection which has no cross marking.



Fig: 4.10 Lack of cross marking

4.4.2 Foot Over Bridge/ Underpasses

These are grade separated crossing. A pedestrian overpass and underpass allows pedestrians safe crossing over busy roads without impacting traffic. In most cases pedestrian choose at grade crossing. But in most busy intersections these are very essential for safe pedestrian crossing. In Dhaka city area the study reveals that about 27% intersections which have foot over bridges and underpasses and about 73% intersections which have no foot over bridges and underpasses which is shown in Fig:4.11.



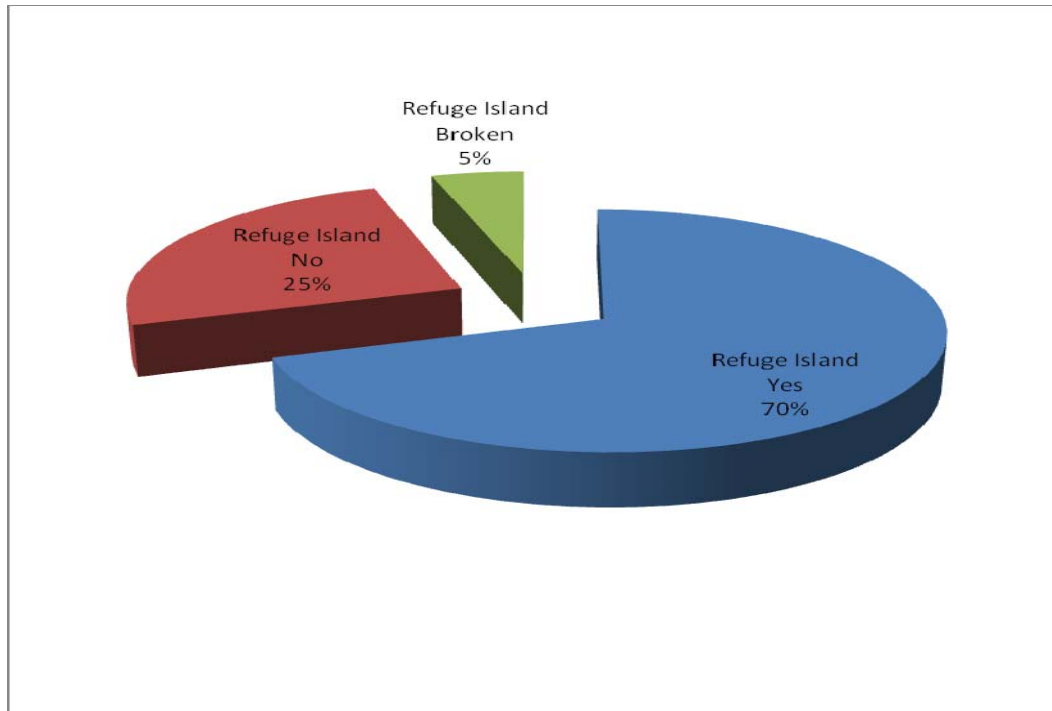
Source: Field Survey 2011

Fig: 4.11 Percentage of intersections having foot over bridge and underpasses

4.4.3 Refuge Island

A refuge island, also known as a pedestrian refuge or pedestrian island, is a small section of pavement or sidewalk, where pedestrians can stop before finishing crossing a road. It is typically used when a street is very wide, as the pedestrian crossing can be too long for some individuals to cross in one traffic light cycle. It is one of the most important facilities for pedestrian road crossing. In Dhaka city the study reveals that about 70%

intersections have refuge islands, about 5% are broken and about 25% intersections have no refuge island which is shown in the following Fig: 4.12.



Source: Field Survey 2011

Fig: 4.12 Percentage of intersections having Refuge Island

4.4.4 Traffic Signals and Traffic Police

Traffic signals are electrically operated traffic control devices which alternately direct traffic to stop and to proceed. This discussion tells what factors enter into traffic engineers' decisions to install traffic signals. Because there is a common belief that signals are the answer to all traffic problems at intersections, this is offered in the interest of developing broader public understanding about what signals will do - and what they won't do.

Traffic guards who are stationed at a crossing with no signal or placed for extra safety at a junction. They stop pedestrians and vehicles from crossing a junction where another thing has the right of way to cross. In addition they have to moderate the traffic density to not cause traffic jams. They guide motorists and pedestrian to follow the traffic laws.

4.5 Pedestrian crossing behavior;

Urban traffic movement pattern has a relationship with the existing urban land use pattern. Existing theories relating patterns of pedestrian and vehicular movement to urban form characterize the problem in terms of flows to and from 'attractor' land uses (UCL, 1999). Land use is a critical component affecting pedestrian behavior; creating an environment where pedestrians are comfortable will maintain a higher pedestrian mode share (Mehndiratta, S. et al 2010). So surrounding land use of the selected intersections has been analyzed. Pedestrian crossing behavior in 6 intersections namely Shahbag, Banglamotor, Sonargaon, Mogbazar, Elephant road and Newmarket were surveyed which consist of pedestrian traffic volume and direction wise pedestrian crossing. It is suggested that the configuration of the urban grid itself is the main generator of patterns of movement. In the study it has been found that intensity and movement pattern of traffic especially pedestrian flows varies due to category of surrounding land uses of the selected intersections described below:

4.5.1 Shahbag Intersection

It is one of the most important intersections under the urban arterial system. A lot of institutions such as Dhaka University, BSMMU, BIRDEM Hospital, Ramna park, Shishu park, Public library and National Museum are situated surrounding this intersection. Huge pedestrian traffic is generated and destined this area. But unfortunately pedestrian traffic route network has not been well developed. This study reveals that a total number of 7140 pedestrian traffic generated in an around the shahbag intersection per hour at peak period. The distribution of one hour pedestrian traffic along with the eight directions has been presented in the figure below. Pedestrian traffic volume per hour of eight direction of this intersection is presented in the following Fig 4.13. The figure is drawn considering the intensity of traffic volume. The figure is drawn based on the condition, $Y/4=X$ where

X = Line width in inch

Y = No. of pedestrian crossing the road in one direction.

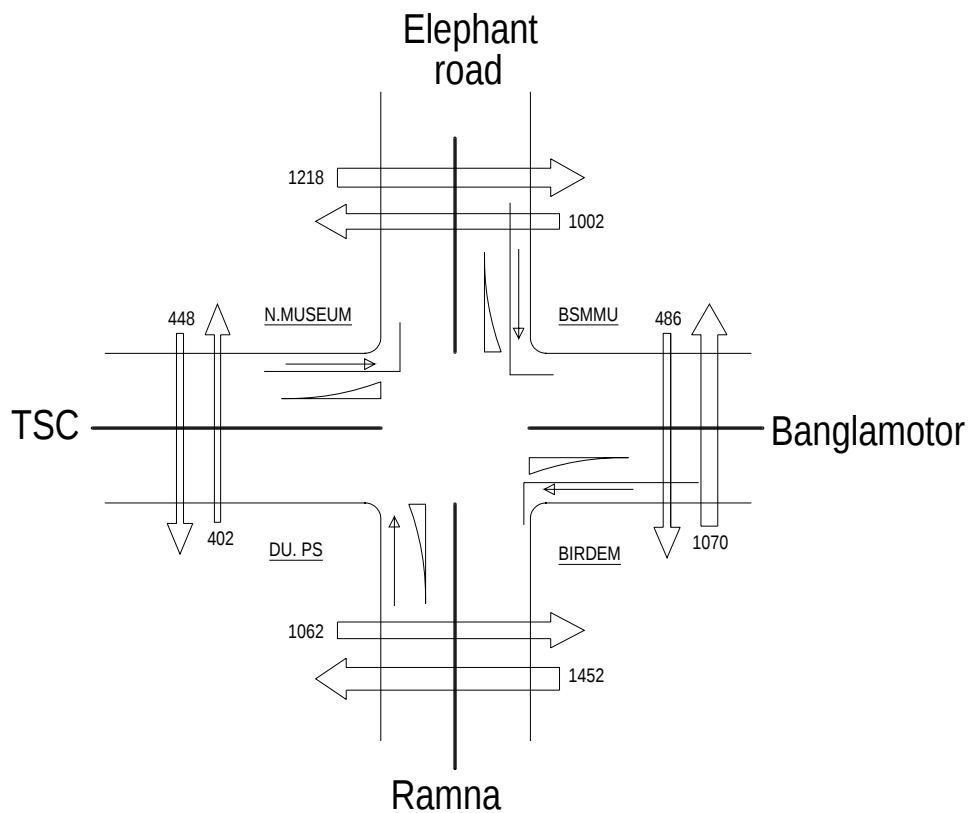


Fig: 4.13 Pedestrian crossing Rate (ped/hr) of Shahbag Intersection at peak period

Total pedestrian crossing at Shahbag intersection which is occurred at evening peak period 5.00pm to 6.00pm is shown in Fig: 4.13. The figure shows total amount of pedestrian crossing including legal and illegal crossing. Here thick arrow represent pedestrian crossing intensity is high and vice-versa. The following Table 4.1 represent amount of pedestrian crossing in signal (Vehicle red in that direction), foot over bridge and risky crossing in each direction and percentage of those crossing at evening peak period. In this table legal cross consist pedestrian crossing with signal and foot over bridge and illegal cross consist risky crossing.

Table 4.1: Status of Pedestrian traffic for Shahbag Intersection

Name (Direction)	Legal cross				Illegal Cross	Percentage (%)	Total Traffic
	signal	Percentage (%)	FOB used	Percentage (%)			
National .Museum To BSMMU	1036	85.05			182	14.95	1218
BSMMU To N.Museum	822	82.03			180	17.97	1002
BSMMU To BIRDEM	305	62.76	144	29.63	37	7.61	486
BIRDEM To BSMMU	402	37.57	580	54.20	88	8.23	1070
BIRDEM To DU.PS	1211	83.40	138	9.50	103	7.10	1452
DU.PS To BIRDEM	691	65.06	258	24.29	113	10.65	1062
DU.PS To N.Museum	350	87.06			52	12.94	402
N.Museum To DU.PS	339	75.67			109	24.33	448
						Total	7140

Source: Field Survey 2010

Legal vs. Illegal Crossing

In this study legal crossing means crossing through using crosswalks and foot over bridge. Illegal crossing is counted pedestrian crossing without crosswalks and during vehicle running using mid blocks. In analyzing the direction wise pedestrian traffic data it has been found that a lot of factors influence the intensity of illegal crossing. The factors which influence the rate of illegal crossing are mainly traffic management pattern, existence of signal, foot over bridges, physical impediment or barriers, lack of imposition or existence of sidewalk barrier and median barrier. Data presented in Table 4.1 shows the highest no. of illegal crossing takes place namely 24.33 % in the direction of ‘National Museum to Dhaka University Police Station’ where foot over bridge is not existed and lack of mechanized signaling system. Movement of pedestrian traffic in an around Shahbag intersection is hindered insufficient foot path, lack of proper traffic management system, invisible traffic sign and signals. Streets and footpath are occupied by hawkers and vendors. The data shows that the most vulnerable direction where the

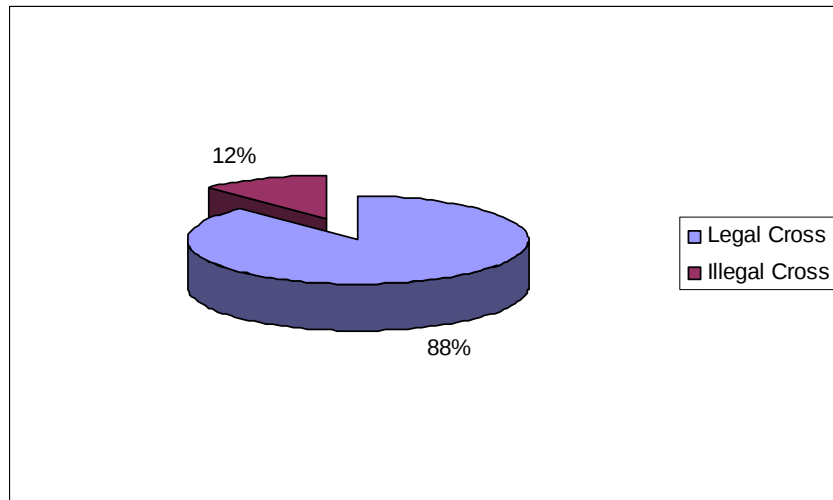
rate of illegal crossing is higher in National Museum to Dhaka University Police Station namely about a quarter (24.33%) of the total pedestrian of this direction. Table 4.2 shows direction wise total no of legal and illegal pedestrian crossing at Shahbag intersection.

Table 4.2: Status of Crossing at Shahbag Intersection

Name of Directions	Legal Cross		Illegal Cross	
	Frequency	%	Frequency	%
N.Museum To BSMMU	1036	85.06	182	14.94
BSMMU To N.Museum	822	82.04	180	17.96
BSMMU To BIRDEM	449	92.39	37	7.61
BIRDEM To BSMMU	982	91.78	88	8.22
BIRDEM To DU.PS	1349	92.91	103	7.09
DU.PS To BIRDEM	949	89.36	113	10.64
DU.PS To N.Museum	350	87.06	52	12.94
N.Museum To DU.PS	339	75.67	109	24.33
Total	6276	87.90	864	12.10

Source: Field Survey 2010

Overall illegal crossing in Shahbag intersection is about 12% which is shown in Fig: 4.13



Source: Field Survey 2010

Fig: 4.14 Legal and Illegal Distribution of Pedestrian crossing for Shahbag Intersection

Pedestrian Crossing Behavior of Shahbag Intersection for One Hour

Crossing Behavior: Type1

Crossing behavior of the pedestrians depend on psychological characteristics as age, gender, awareness level of the pedestrians as well as modal characteristics, vehicular speed, presence foot over bridge and overall traffic management pattern prevailing in respective intersection. In Shahbag, it is mostly found that the pedestrians are intended to form a group as cordon to cross the road where vehicle speed is comparatively higher. Such types of crossing behavior were identified in Shahbag intersection which is much popularized intersections. Table 4.3 shows in Shahbagh intersection, the form of cordon is noticed to be higher namely 66.67% where the form of single crossing and double (two person together) crossing were 26.67% and 6.67% respectively. The reason of higher rate of cordon is considered as high vehicular speed.

Table 4.3: Percentage of Crossing by Single, Double and Group at Shahbag Intersection per Hour

Type of Crossing	No. of Pedestrian	Percentage (%)
Single	1904	26.67
Double	476	6.67
Cordon or group	4760	66.67
Total	7140	100.00

Crossing Behavior: Type2

The pedestrians are noticed to walk normally represented by 86.90% where they are noticed to run quickly by 13.10% which is shown in the following Table 4.4. Such type of crossing by running is highly risky and any fatal injuries or deceased may be happened any time.

Table 4.4: Percentage of Crossing by Walking and Running at Shahbag Intersection per Hour

Type of Crossing	No. of Pedestrian	Percentage(%)
Walking	6205	86.90
Running	935	13.10
Total	7140	100.00

Crossing Behavior: Type3

This type of crossing behavior is classified in three categories for analysis. Some of them are found to use zebra crossing timely which is also legal crossing. Some pedestrians run quickly in mid block section. A group of them are noticed to cross diagonally which type of crossing poses higher probability of fatal accidents at any time. In Shahbag intersection it was found to use zebra crossing by 85% of them where they were noticed to use midblock by 6.67% of them. About 8.33% of them are noticed to follow very risky diagonal crossing which is shown in the following Table 4.5.

Table 4.5: Percentage of Crossing by Zebra, Midblock and Diagonal crossing at Shahbag Intersection per Hour

Type of Crossing	No. of Pedestrian	Percentage(%)
Use zebra Crossing	6069	85.00
Use Mid Block	476	6.67
Diagonal	595	8.33
Total	7140	100.00

4.5.2 Magbazar Intersection

Magbazar Intersection is one of the important nodes in transportation network of Dhaka metropolitan area. Huge no. of pedestrian traffic is generated in and around it. As it is located at the important location connected residential areas like Eskaton, Malibagh, Siddheswari, shopping areas as Mouchak market and recreational zones of Ramna park and so on. Among the studied intersections this is provided with a well designed foot over bridge covering four directions and seems to have sound pedestrian infrastructure. But unfortunately there is found huge illegally crossing pedestrian traffic in this intersection. This study reveals that a total number of 4393 pedestrian traffic generated in and around the Magbazar intersection. The survey was conducted at peak period of 5.00 to 6.00 pm along all the direction of Maghbazar Intersection. The four corners of the intersection are shown 1,2,3,4 for directional flow analysis of the pedestrians. Pedestrian traffic volume per hour of eight direction of this intersection is presented in the following Fig: 4.15. The figure is drawn considering the intensity of traffic volume. The traffic volume showing in the figure include both legal and illegal pedestrian crossing.

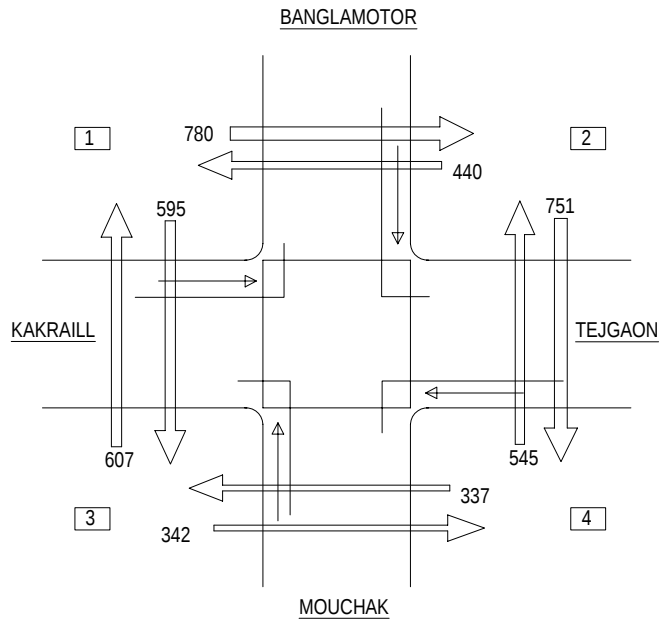


Fig: 4.15 Pedestrian crossing Rate (ped/hr) of Maghbazar Intersection at peak period

In Maghbazar intersection pedestrian crossing rate is high at 1 to 2 direction which is shown in Fig: 4.16

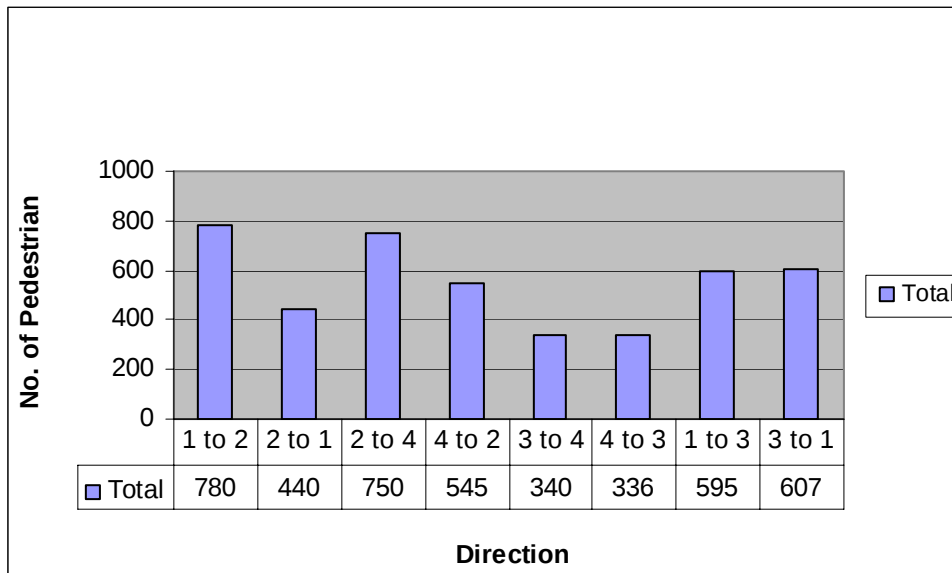


Fig: 4.16 No. of Pedestrian Traffic in all Directions for Maghbazar Intersection

The study reveals that a total of 4339 pedestrian cross in different directions of this intersection. Detailed One Hour pedestrian Crossing Data for Maghbazar Intersection has been mentioned in Table 4.6

Table 4.6: Status of Pedestrian traffic for Maghbazar Intersection

Name (Direction)	Legal cross				Illegal Cross	Percentage (%)	Total
	signal	Percentage (%)	FOB Used	Percentage (%)			
1 to 2	400	51.28	102	13.08	278	35.64	780
2 to 1	210	47.73	43	9.77	187	42.5	440
2 to 4	305	40.67	22	2.93	423	56.4	750
4 to 2	240	44.04	42	7.71	263	51.75	545
3 to 4	64	18.82	24	7.06	252	74.12	340
4 to 3	121	36.01	20	5.95	195	58.04	336
1 to 3	241	40.50	72	12.10	282	52.60	595
3 to 1	306	50.41	55	9.06	246	40.53	607
						Total	4393

Source: Field Survey 2010

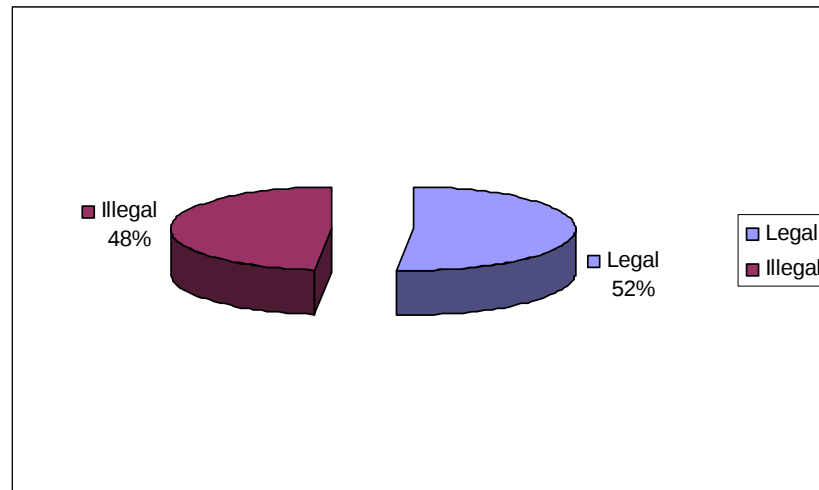
The following Table 4.7 shows direction wise legal and illegal pedestrian crossing for Maghbazar intersection. Illegal crossing is high at 2 to 4 direction.

Table 4.7 : Legal Vs Illegal crossing for Maghbazar Intersection

Name (Direction)	Legal cross	Illegal cross
1 to 2	502	278
2 to 1	253	187
2 to 4	327	423
4 to 2	282	263
3 to 4	88	252
4 to 3	141	195
1 to 3	313	282
3 to 1	361	246
Total	2267	2126

Source: Field Survey 2010

Among the total pedestrians it reveals that about 52% crosses legally by crosswalks and foot over bridge and about 48% crosses illegally which is shown in Fig: 4.17.



Source: Field Survey 2010

Fig: 4.17 Legal and Illegal Distribution of Pedestrian crossing for Maghbazar Intersection

During vehicle green time they make cordon and crosses in a platoon which is a great threat for pedestrian safety. Any time severe accident may happen. Although guardrail exists there due to lack of compulsory imposition and options for crosswalk the rate of illegal crossing is higher in this intersection.

4.5.3 New Market Intersection

It is another important intersection under the urban arterial system. A lot of pedestrian traffic generated in and around New market area. As it is located at the important location surrounding Dhaka University, Eden college, Azimpur, Lalbag residential area, Govt staff quarters, Bangladesh University of Engineering and Technology (BUET) and so on. Huge pedestrian traffic is generated and destined this area. But unfortunately pedestrian traffic route network has not been well developed. Pedestrian traffic volume per hour of eight direction of this intersection is presented in the following Fig 4.18. The figure is drawn considering the intensity of traffic volume. The traffic volume showing in the

Fig: 4.18 include both legal and illegal pedestrian crossing. The figure is drawn based on the principles and conditions mentioned previously.

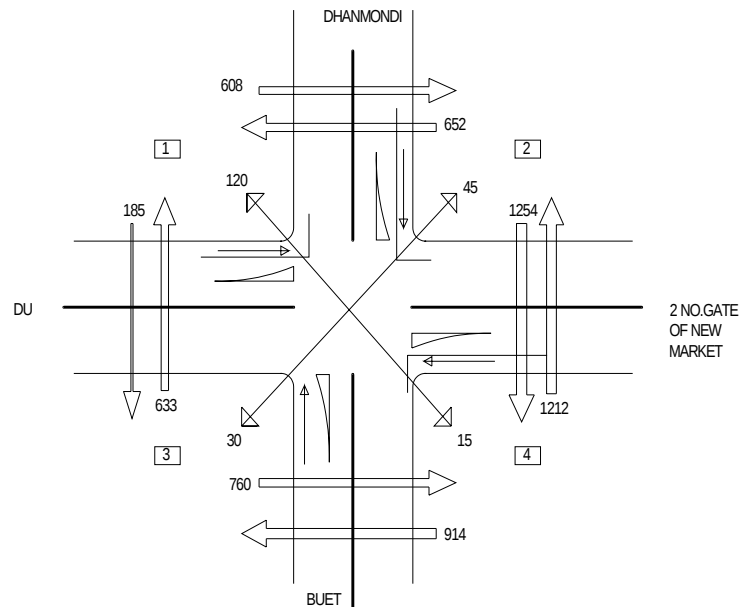


Fig: 4.18 Pedestrian crossing Rate (ped/hr) of Newmarket Intersection at peak period

This study reveals that a total number of 6218 pedestrian traffic generated in an around the Newmarket intersection per hour. More illegal crossing occur at Nilkhet book stall to Newmarket direction is 21.20%. The following Table 4.8 shows the details of pedestrian crossing at Newmarket intersection.

Table 4.8 Status of Pedestrian traffic for Newmarket Intersection

Name (Direction)	Legal cross				Illega l Cross	Percen tage (%)	Total
	signal	Perce ntage (%)	FOB used	Perce ntage (%)			
Quarter To Newmarket	558	91.77			50	8.23	608
Newmarket To Quarter	587	90.03			65	9.97	652
Nilkhet book stall To Newmarket	780	64.35	175	14.45	257	21.20	1212
Newmarket To Nilkhet book stall	827	65.95	187	14.91	240	19.14	1254

Nilkhet bedding stall To Quarter	586	92.57			47	7.43	633
Quarter To Nilkhet bedding stall	168	90.81			17	9.19	185
Nilkhet bedding stall To Nilkhet book stall	615	80.92			145	19.08	760
Nilkhet book stall to Nilkhet bedding stall	743	81.29			171	18.71	914
						Total	6218

The study reveals that the over all illegal crossing of Newmarket intersection is about 16% which is shown in Fig: 4.19.

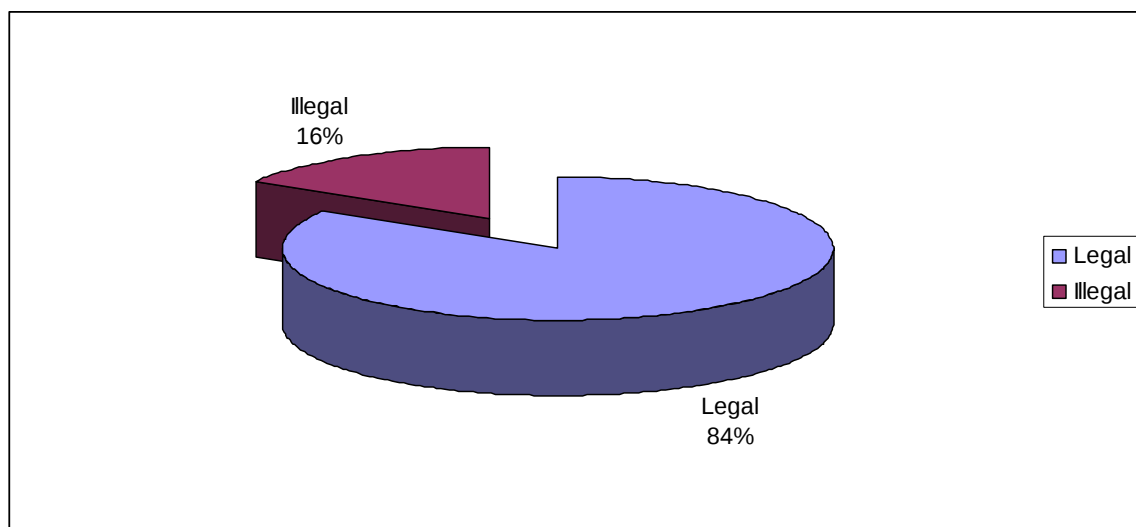


Fig: 4.19 Legal and Illegal Distribution of Pedestrian crossing for Newmarket Intersection

Pedestrian Crossing Behavior of Newmarket Intersection for One Hour

Crossing Behavior: Type1

Crossing behavior of the pedestrians depend on psychological characteristics as age, gender, awareness level of the pedestrians as well as surrounding land use, modal distribution, types of generating traffic, vehicle speed and traffic management pattern of

the intersection. In Newmarket intersection, there is found multimodal vehicle operations in combination with motorized and non motorized traffic. As a result vehicle speed is comparatively slow. There is found crossing by single person namely 57.14% followed by dual crossing and cordon namely 28.56% and 14.30% respectively which is shown in Table 4.9. It is found that surrounding land use is another factor influencing crossing behavior. As it is dominated by shopping area the rate of single person crossing is higher in this intersection.

Table 4.9: Percentage of Crossing by Single, Double and Group at Newmarket Intersection per Hour

Type of Crossing	No. of Pedestrian	Percentage (%)
Single	3553	57.14
Double	1776	28.56
Cordon or group	889	14.30
Total	6218	100.00

Crossing Behavior: Type2

This type of crossing depends on vehicular speed, modal split of slow and fast moving vehicles. As Newmarket intersection is characterized by mix modal agglomeration, vehicular speed is comparatively slow. The pedestrians are noticed to walk normally represented by 76.28% where they are noticed to run quickly by 23.71% which is mentioned in the following Table 4.10. Such type of crossing by running is highly risky and any fatal injuries or decease may be happened any time.

Table 4.10: Percentage of Crossing by Walking and Running at Newmarket Intersection per Hour

Type of Crossing	No. of Pedestrian	Percentage(%)
Walking	4743	76.28
Running	1474	23.71
Total	6218	100.00

Crossing Behavior: Type3

This type of crossing behavior is classified in three categories for analysis. Some of them are found to use zebra crossing timely which is also legal crossing. Some pedestrians run quickly in mid block section. A group of them are noticed to cross diagonally which type

of crossing poses higher probability of fatal accidents at any time. In Newmarket intersection it was found to use zebra crossing by 55.71% of them where they were noticed to use midblock by 37.15% of them. About 7.14% of them are noticed to follow very risky diagonal crossing which is shown in the following Table 4.11.

Table 4.11: Percentage of Crossing by Zebra, Midblock and Diagonal crossing at Newmarket Intersection per Hour

Type of Crossing	No. of Pedestrian	Percentage(%)
Use zebra Crossing	3464	55.71
Use Mid Block	2310	37.15
Diagonal	444	7.14
Total	6218	100.00

4.5.4 Elephant Road Intersection

It is one of the most important intersections under the urban arterial system. It is 3-way intersection. The Elephant road intersection has a foot over bridge. A lot of pedestrian traffic generated. As it is located at the important location connecting Dhanmondi, Mirpur road, elephant road shopping area, science laboratory, Hatirpul, Kataban and Shahbag, huge pedestrian traffic is generated and destined this area. Pedestrian traffic volume per hour of eight direction of this intersection is presented in the following Fig: 4.20. The figure is drawn considering the intensity of traffic volume. The traffic volume showing in the figure include both legal and illegal pedestrian crossing. The figure is drawn based on the principles and conditions mentioned previously.

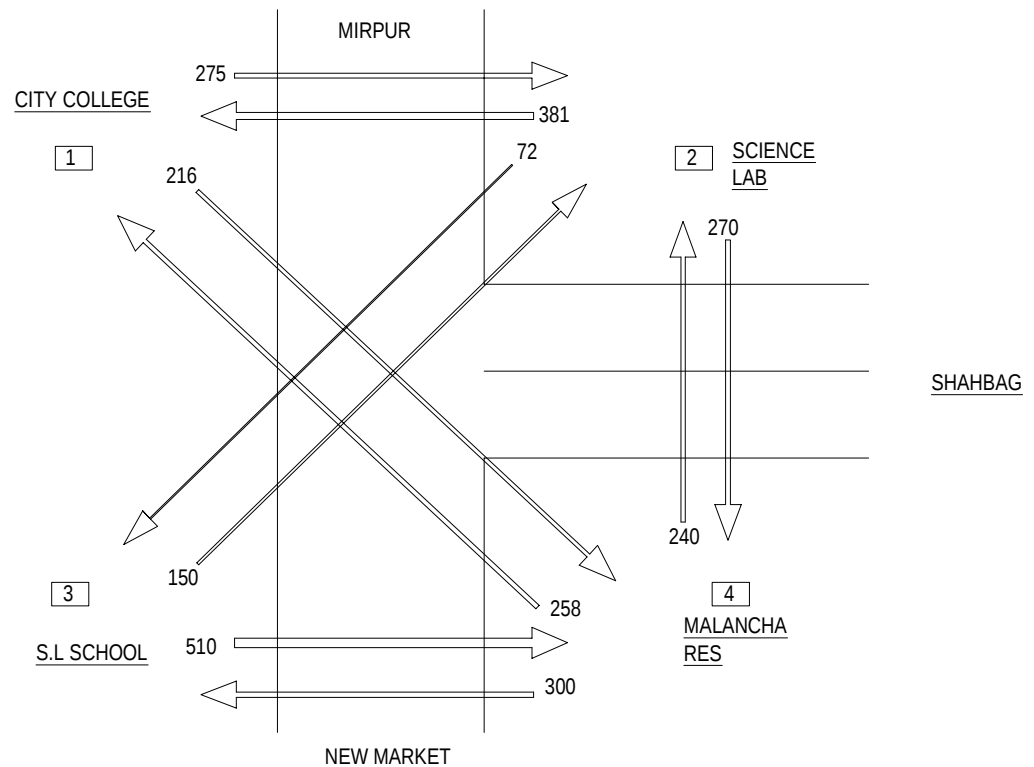


Fig: 4.20 Pedestrian crossing Rate (ped/hr) of Elephant Road Intersection at peak period

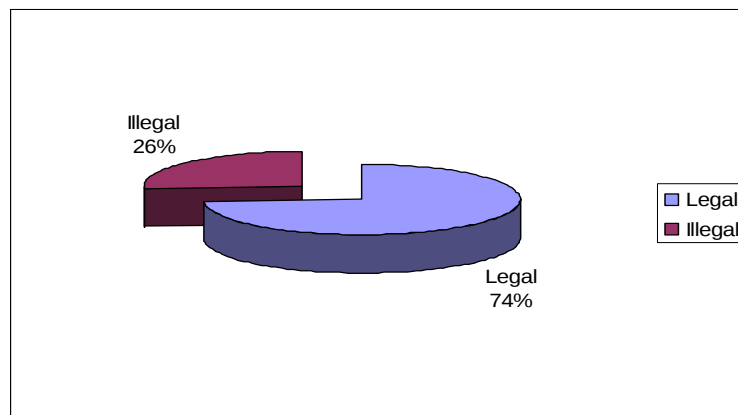
This study reveals that a total number of 2673 pedestrian traffic generated in an around the Elephant Road Intersection per hour at peak period. More pedestrian crossings occur at the direction of S.L School to Malancha restaurant. More illegal crossing occur at Malancha restaurant to Science Laboratory School direction is 68% which is shown in the following Table 4.12.

Table 4.12: Status of Pedestrian traffic for Elephant Road Intersection

Name (Direction)	Legal cross				Illegal Cross	Percent age (%)	Total
	signal	Perce ntage (%)	FOB used	Perce ntage (%)			
Malancha restaurant to Science Laboratory School			96	32.00	204	68.00	300
S.L School To Malancha restaurant			210	41.18	300	58.82	510
City College To Malancha restaurant			216	100.00			216
Malancha restaurant To City College			258	100.00			258
Science .Laboratory School To Science .Laboratory			150	100.0			150
Science .Laboratory To Science .Laboratory School			72				72
Science .Laboratory To City College			336	88.19	45	11.81	381
City College To Science .Laboratory			246	89.13	30	10.87	276
Science .Laboratory To Malancha	215	79.63			55	20.37	270
0Malancha To Science .Laboratory	180	75.00			60	25.00	240
						Total	2673

Source: Field Survey 2010

The study reveals that the over all illegal crossing at Elephant road intersection is 26% which is shown in Fig: 4.21



Source: Field Survey 2010

Fig: 4.21 Legal and Illegal Distribution of Pedestrian crossing for Elephant Road Intersection

4.5.5 Sonargaon Intersection

It is one of the most important intersections under the urban arterial system. It is a 5-way intersection. It has an underpass in the farmgate direction. A lot of pedestrian traffic generated in this intersection. As it is located at the important location connection Pan Pacific Sonargaon hotel, Bashundhara shopping mall, Panthapath commercial area, Kawran bazaar whole sale market and Kathalbagan mixed use zone, huge pedestrian traffic is generated and destined this area. Although here exist an underpass near about 20 meter from this intersection it contributes to divert some pedestrian in one direction only. This study reveals that a total number of 6948 pedestrian traffic generated in an around the Sonargaon Intersection in the survey period 5 p.m. to 6 p.m. intersection.

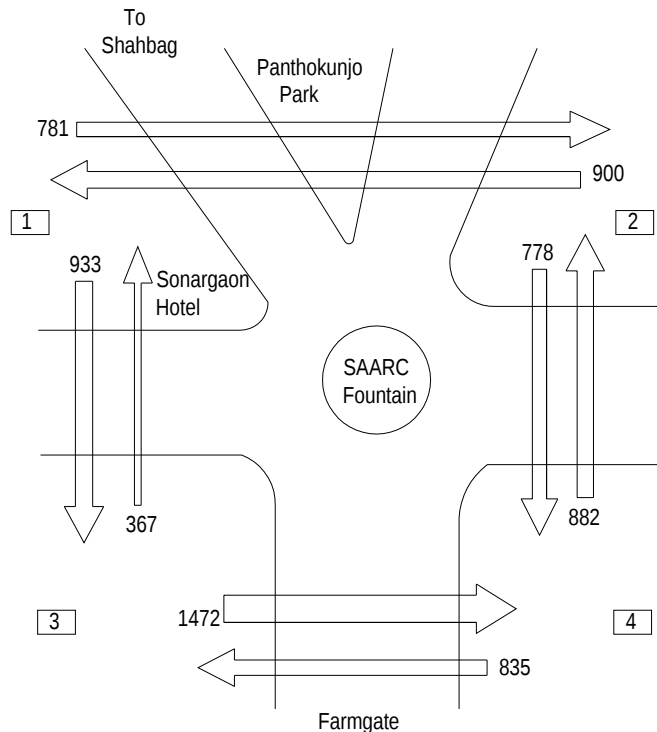


Fig: 4.22 Pedestrian Crossing Rate (ped/hr) of Sonargaon Intersection

Pedestrian traffic volume per hour of eight direction of this intersection presented in the following Fig 4.22. The intersection generates huge pedestrian traffic in all directions. The figure is drawn considering the intensity of traffic volume. The traffic volume showing in the figure include both legal and illegal pedestrian crossing. The figure is drawn based on the principles and conditions mentioned previously. Table 4.13 shows legal and illegal crossing and percentage of those crossing. In this intersection more illegal crossing occurs at 4 to 3 direction about 27%.

Table 4.13: Status of Pedestrian traffic for Sonargaon Intersection

Name (Direction)	Legal cross		Illegal Cross	Percentage (%)	Total
	signal	Percentage (%)			
1 to 2	649	83.09	132	16.91	781
2 to 1	783	87.00	117	13.00	900
2 to 4	631	81.10	147	18.90	778
4 to 2	687	77.89	195	22.11	882
3 to 4	1119	76.02	353	23.98	1472
4 to 3	611	73.17	224	26.83	835
1 to 3	739	79.21	194	20.79	933
3 to 1	275	74.93	92	25.07	367
				Total	6948

Source: Field Survey 2010

Fig: 4.23 shows overall pedestrian crossing at eight direction including legal and illegal crossing. More pedestrian crossings occur at 3 to 4 direction which is shown in the following figure.

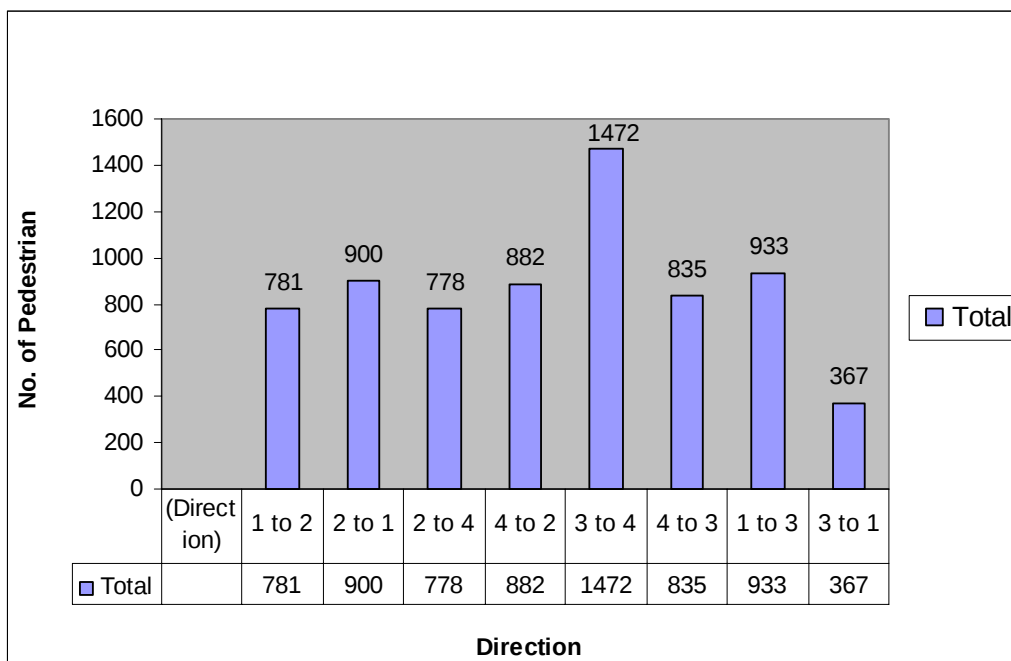


Fig: 4.23 Direction wise One Hour Pedestrian Crossing Data for Sonargaon Intersection

The following figure shows the over all illegal crossing of Sonargaon intersection is 21%.

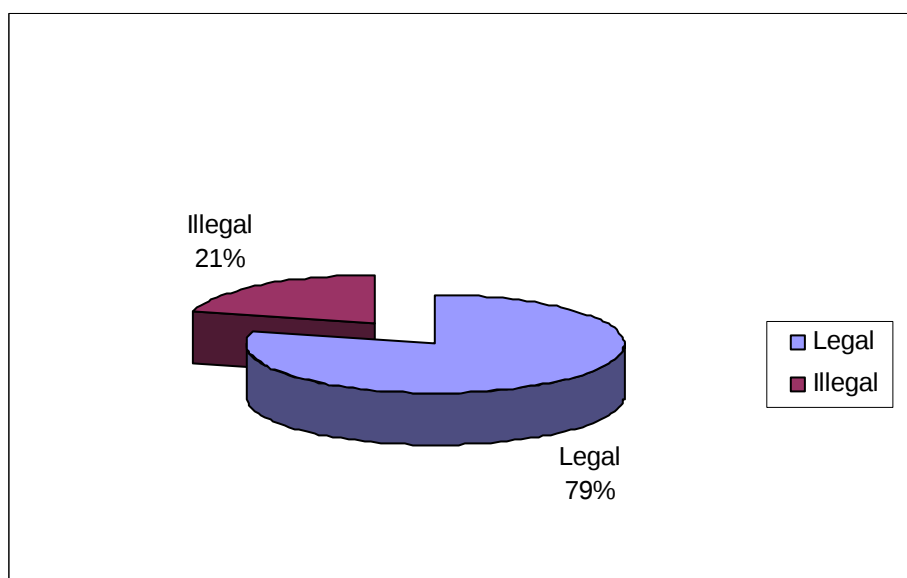


Fig: 4.24 Legal and Illegal Distribution of Pedestrian crossing for Sonargaon Intersection

Pedestrian Crossing Behavior of Sonargaon Intersection for One Hour

Crossing Behavior: Type1

Crossing behavior of the pedestrians depends on traffic speed, modal distribution and characteristics of traffic management. In Sonargaon Intersection, it is mostly found that the pedestrians are intended to form a group as cordon to cross the road where vehicle speed



Fig: 4.25 Crossing in a cordon

is comparatively higher. In Sonargaon intersection, the form of cordon is noticed to be higher namely 78.17% where the form of single crossing and double (two person together) crossing were 12.77% and 9.06% respectively which is shown in the following Table 4.14.

Table 4.14: Percentage of Crossing by Single, Double and Group at Sonargaon Intersection per Hour

Type of Crossing	No. of Pedestrian	Percentage(%)
Single	887	12.77
Double	630	9.06
Cordon or group	5431	78.17
Total	6948	100.00

Crossing Behavior: Type2

The pedestrians are noticed to walk normally represented by 94.44% where they are noticed to run quickly by 5.56% which is shown in the following Table 4.15. Such type of crossing by running is highly risky and any fatal injuries or deceased may be happened any time.

Table 4.15: Percentage of Crossing by Walking and Running at Sonargaon Intersection per Hour

Type of Crossing	No. of Pedestrian	Percentage(%)
Walking	6562	94.44
Running	386	5.56
Total	6948	100.00

Crossing Behavior: Type3

This type of crossing behavior is classified in three categories for analysis. Some of them are found to use zebra crossing timely which is also legal crossing. Some pedestrians run quickly in mid block section. A group of them are noticed to cross diagonally which type of crossing poses higher probability of fatal accidents at any time. In Sonargaon intersection it was found to use zebra crossing by 92.58% of them where they were noticed to use midblock by 5.56% of them. About 1.86% of them are noticed to follow very risky diagonal crossing which is shown in the following Table 4.16.

Table 4.16: Percentage of Crossing by Zebra, Midblock and Diagonal crossing at Sonargaon Intersection per Hour

Type of Crossing	No. of Pedestrian	Percentage(%)
Use zebra Crossing	6433	92.58
Use Mid Block	386	5.56
Diagonal	129	1.86
Total	6948	100.00

4.5.6 Banglamotor Intersection

It is one of the most important intersections under the urban arterial system. It is 4-way intersection. It has a foot over bridge in Sonargaon direction. A lot of pedestrian traffic generated in this intersection. As it is located at the important location connection of Kazi Nazrul Islam avenue, Banglamotor, New Eskaton, Dhaka Sheraton hotel, BSMMU, BIRDEM Hospital and so on, huge pedestrian traffic is generated and destined in this area. But unfortunately pedestrian traffic route network has not been well developed. The intersection generates huge pedestrian traffic in all directions is presented in the following Fig 4.26. The figure is drawn considering the intensity of traffic volume. The traffic volume showing in the diagram include both legal and illegal pedestrian crossing. The figure is drawn based on the principles and conditions mentioned previously.

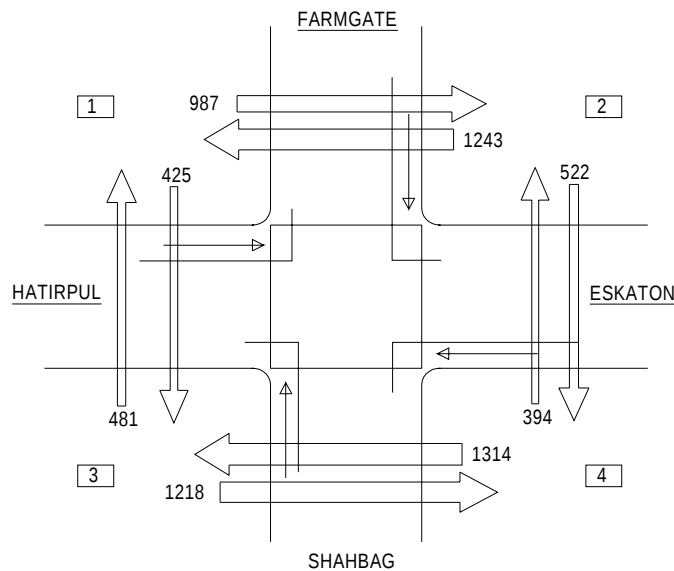


Fig: 4.26 Pedestrian Crossing Rate (ped/hr) of Banglamotor Intersection

This study reveals that a total number of 6584 pedestrian traffic generated in an around the Banglamotor Intersection. Pedestrian traffic volume per hour of eight direction of this intersection is presented in the following Table 4.17 which contains the amount of legal

cross and illegal cross and percentage of those cross. Table 4.17 shows more illegal crossing occurs at 4 to 2 direction about 21%.

Table 4.17: Status of Pedestrian traffic for Banglamotor Intersection

Name (Direction)	Legal cross				Illegal Cross	Percentage (%)	Total
	signal	Percentage (%)	FOB used	Percentage (%)			
1 to 2	375	37.99	417	42.25	195	19.76	987
2 to 1	591	47.55	518	41.67	135	10.78	1243
2 to 4	445	85.25			77	14.75	522
4 to 2	311	78.93			83	21.07	394
3 to 4	1083	88.92			135	11.08	1218
4 to 3	1206	91.78			108	8.22	1314
1 to 3	369	86.82			56	13.18	425
3 to 1	439	91.27			42	8.73	481
							6584

Source: Field Survey 2010

More pedestrian crossings occur at 4 to 3 direction is 1314 per hour at peak period which is shown in the Fig: 4.27.

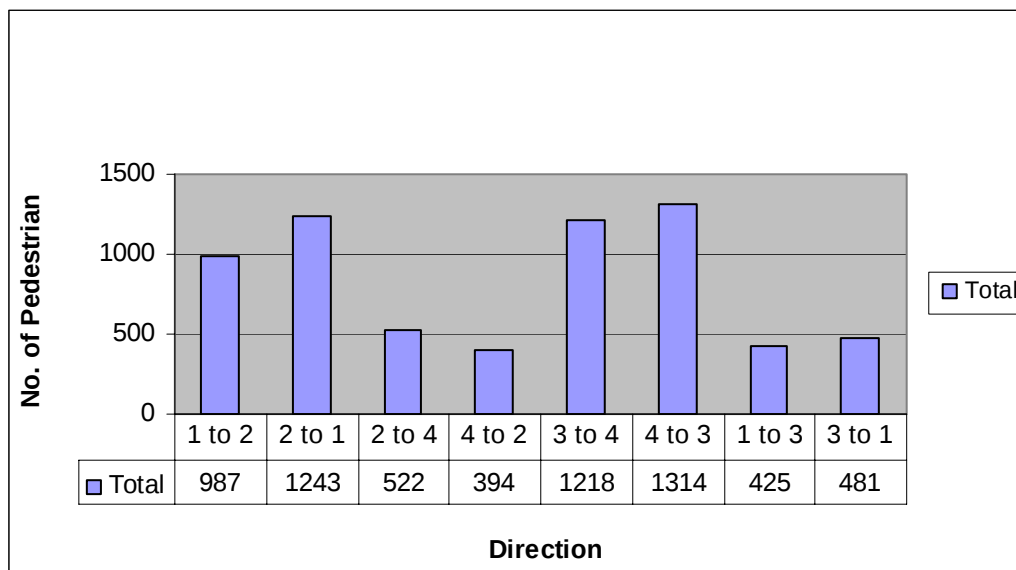
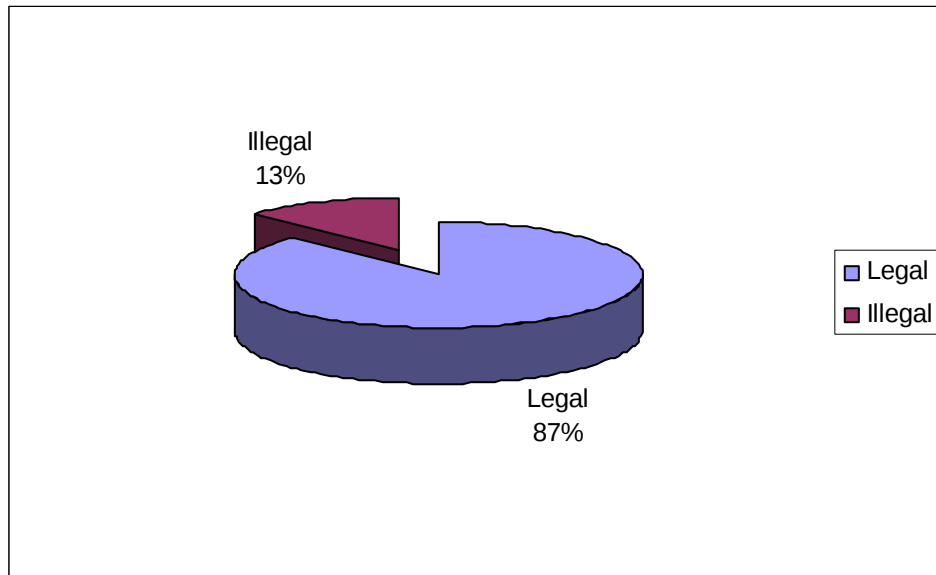


Fig: 4.27 Direction wise Pedestrian Crossing One Hour Pedestrian Crossing Data Banglamotor Intersection

The following figure shows the over all illegal crossing of Banglamotor intersection is about 13%.



Source: Field Survey 2010

Fig: 4.28 Legal and Illegal Distribution of Pedestrian crossing for Banglamotor Intersection

4.6 Problems associates with pedestrian crossing at Intersections in Dhaka city

One of the major problems associated with pedestrian crossing is lack of visible cross marking among the existing intersections of Dhaka city. The study reveals that only 30% of the signalized intersections are provided with visible cross marking. This is a great threat to the safety of pedestrian crossing in Dhaka city.

There does not exist enough footpaths, crossing facilities in most of the intersections. In many cases footpath exist but in dilapidated poor physical condition and poorly provided with the crossing facilities. There is possibility with multiple threat collision because

there is not enough stop bar/ speed breaker to stop back far enough from the crossing points.

The study reveals that a quarter of the surveyed intersections are not provided with any median and refuge island where people cross the road in unsafe way. Median island is necessary to split the traffic in two groups to cross the road.

In many cases illegal parking is found near the visible cross marks which obstacles pedestrian crossing and is a threat for safety. Street lighting around the crossing is found to be inadequate. As a result the visible cross marks are not easily captured by the vehicle drivers to have stopping sight distance to avoid collision.

CHAPTER: FIVE

EVALUATION OF EXCLUSIVE PEDESTRIAN PHASE

5.1 Introduction

An Exclusive Pedestrian Phase which is known as a pedestrian scramble is a pedestrian crossing system that stops all vehicular traffic and allows pedestrians to cross an intersection in every direction, including diagonally, at the same time. It is also known as a 'X' Crossing in UK, diagonal crossing in USA, scramble intersection in Canada, and more poetically it is also called as Barnes Dance.

5.2 Global Perspectives

Pedestrian scramble phasing is also commonly referred to as “exclusive pedestrian phase”, “pedestrian criss-cross”, “scramble lights”, “scatter lights”, “scramble corners” and “Barnes Dance”. The last mentioned terminology is named after Henry Barnes, the prominent traffic engineer, who is credited to be the first to use the system in Kansas City (Kansas) and Vancouver (Washington) and then later in Denver (Colorado), Baltimore (Maryland) and New York City (New York). The terminology came from an article written by a reporter who stated “Barnes had made the people so happy they’re dancing in the streets” (Bissessar, R. et al, 2010). It was first used in Canada and the United States in the late 1940's and has since then been adopted in many other cities and countries. Though it fell out of favour with traffic engineers in some countries for a while as it prioritizes pedestrians higher (and thus more than cars, in some situations), the understanding of the benefits in terms of pedestrian amenity and safety have led to new examples being installed in many countries in recent years. The most famous implementation of this kind of intersection is present in Shibuya, Tokyo.



Fig 5.1: Pedestrian scrambles at Hachik Square, Shibuya, Tokyo



Fig: 5.2: Diagonal crossing in Cologne, Germany

It exists in Cologne, Germany, King George Street and Jaffa Road pedestrian scramble in Jerusalem, Israel (2007). Oxford Circus in London with a new pedestrian scramble was opened in November 2009.



Fig: 5.3: Pedestrian scramble at New York City's Union Square.

In a typical situation, signal design requirements include development of a phase plan & sequence, determination of cycle length, allocation of effective green time or green split, establishment of yellow and all red for each phase, checking pedestrian crossing requirements (Mannering, Fred L. et al 2007). Here phase can be defined as part of cycle allocated to any combination of traffic movements receiving the right of way simultaneously during one or more interval. Cycle length is the total time for signal to complete one cycle.



Photo 6.30 – Signals with exclusive pedestrian (scramble) phase, Auckland (Photo: Judith Goodwin)

Fig 5.4: Pedestrian scramble at Auckland, New Zealand

An exclusive ‘scramble crossing’ or ‘barnes dance’ phase can allow pedestrians to cross safely on the diagonal, minimizing their overall travel distance while eliminating vehicle conflicts, but at the expense of extra pedestrian and vehicle delay. The safety benefits will diminish to the extent that extra delays result in non-compliance. The pedestrian phase can be advanced to give pedestrians an early start (and hence position them where drivers are more likely to notice and give way). The turning needs of large vehicles can be catered for in a pedestrian friendly way by providing appropriate slip lanes.

Exclusive pedestrian phase (also “pedestrian scramble” or “Barnes’ Dance”) as shown in the above Figures an exclusive pedestrian phase dedicates an additional phase for the exclusive use of all pedestrians. This additional phase is configured such that no vehicular movements are served concurrently with pedestrian traffic. During this phase, pedestrians can cross any of the intersection legs and may even be allowed to cross the intersection in a diagonal path. This type of phasing has an advantage of reducing conflicts between right-turning vehicles and pedestrians, but it comes at a penalty of reduced vehicular capacity and longer cycle lengths (which increases delay to all users).

The exclusive pedestrian phase is not frequently used but can be found in the central business districts of several cities, including Denver and San Francisco.

Pedestrian scramble phasing is one of the enhanced pedestrian features for traffic control signals identified in Toronto's "Steps Towards a Walkable City" (Bissessar, R. et al, 2010). City Council, at its meeting on October 22 and 23, 2007 approved the introduction of "pedestrian scramble phases (Barnes' dance) at appropriate locations on a pilot project basis". The intersections chosen were Bloor Street/Bay Street, Bloor Street/Yonge Street, Yonge Street/Dundas Street and Bay Street/Dundas Street – all four intersections are in the downtown core. It was decided that the Yonge Street/Dundas Street intersection would be installed first because of planned reconstruction at the other three intersections; the implementation occurred on August 28, 2008. The Yonge Street/Dundas Street intersection has a four-lane cross-section on Yonge Street and Dundas; the inner eastbound and westbound lanes on Dundas Street are occupied by streetcar tracks on which both streetcars and mixed traffic are allowed.

In Calgary, there were a number of Aldermen who were interested in pedestrian scramble phasing and wanted to bring this type of control to the city. The Transportation Department took the initiative to identify and review several candidate locations before deciding upon two locations in the Eau Claire Market area, a pedestrian-oriented shopping area that is adjacent to the city's river pathway system (Bissessar, R. et al, 2010). The intersections attract a high number of walkers and joggers. In pedestrian counts taken before the launch of the project, the intersections were averaging about 6,000 pedestrians each during the peak six hours of the day. On May 12, 2008, the City of Calgary implemented scramble phasing at the 3 Street /2 Avenue SW and 3 Street/3 Avenue SW intersections. Both intersections have a two-lane cross-section in the east-west and north-south directions.

5.3 Successful best practices of EPP

Beverly Hills, USA

The residential population of Beverly Hills was about 35,000 (Vaziri, 1996). However, the daytime population was estimated at about 150,000, mostly concentrated in the Business District, which is informally called the “Business Triangle.” Daytime pedestrian activity is very heavy in the Business District due to the concentration of businesses and services and the high volume of tourists visiting the area around famous Rodeo Drive. The primary concern for the City was the high number of conflicts between pedestrians and vehicles at many of the intersections, especially during holidays and peak tourist seasons. Large pedestrian flows were blocking crosswalks to turning traffic during the entire green signal phase (Vaziri, 1996). A review of the accident history revealed several reported vehicle-pedestrian accidents. Numerous field observations also concluded many “close calls” occurred.

In 1987, the City of Beverly Hills modified traffic signals at eight intersections to include an exclusive pedestrian phase where all approaches would stop to let pedestrians cross the intersection either diagonally or conventionally. With exclusive pedestrian phases in place, pedestrians were allowed to cross diagonally as well as conventionally. In that case, the longer diagonal pedestrian path was used to determine the optimal clearance time for that signal phase. A range of 20-22 seconds of total pedestrian signal phase was determined to be appropriate (Vaziri, 1996). At the time, all Business Triangle signals were operating on 50-second cycles, and the introduction of the pedestrian phase increased the cycle to 60 seconds to clear vehicles through the intersections. After implementation, it seemed that people became accustomed to the new operation. Public opinion has been very favorable, and other communities have contacted the City about their successful operation.

A capacity analysis was conducted as part of the evaluation of the new signal operation (Vaziri, 1996). Using the “ICU” method, a level of service (LOS) was calculated before and after the implementation of the exclusive pedestrian phase. The following Table 5.1

shows the summary of the LOS calculations. The analysis indicated that for most intersections, the change in LOS was within an acceptable range.

Table 5.1: LOS Calculations Before and After Implementation.

Intersection	Before LOS	After LOS
Brighton / Canon	.40 A	.63 B
Brighton / Beverly	.69 B	.92 E
Brighton / Rodeo	.48 A	.71 C
Brighton / Camden	.40 A	.66 B
Brighton / Bedford	.34 A	.57 A
Dayton / Canon	.31 A	.54 A
Dayton / Beverly	.55 A	.81 D
Dayton / Rodeo	.34 A	.57 A

Source: Vaziri, 1996

Since the primary objective of this project was to improve safety, detailed evaluation of accidents of all eight intersections was conducted. Accident data from the years 1978, 1987, and 1996 were used for comparison. The primary focus was to examine the auto/pedestrian type accidents before and after the implementation of the project. The following Table 5.2 shows the average change in accidents over the comparison periods.

Table: 5.2 Summaries of Auto/Pedestrian Accidents Before and After the Pedestrian Phase

Intersections	Before		After	
	# of accidents	% of total accidents	# of accidents	% of total accidents
1 - Brighton/Canon	3	18%	1	10%
3 - Brighton/Rodeo	5	18%	3	11%
4 - Brighton/Camden	2	22%	0	00%
5 - Brighton/Bedford	2	11%	2	18%

6 - Dayton/Canon	4	31%	0	00%
8 - Dayton/Rodeo	2	13%	0	00%
Total	18	19%	6	7%

Source: Vaziri, 1996

The table indicates a reduction in auto/pedestrian accidents by 66% between 1987 and 1996 for the six intersections that maintained the pedestrian phase. Data have suggested unequivocally that this project was a success. Further, overall accidents in the Business Triangle were reduced by 26%. However, at those two intersections where the pedestrian phase was eliminated (Brighton/ Beverly and Dayton/Beverly), auto/pedestrian accident rates remained the same or even increased.

San Diego, California

Due to the high volume of pedestrians at intersections in Downtown of San Diego, California, the Center City Development Corporation (CCDC) has proposed a pedestrian-friendly intersection improvement project in 2001. The project was to add intersection pop outs and an exclusive pedestrian signal so called “Pedestrian Scramble” at the intersection of 5th Avenue and Market Street. This project was proposed to improve pedestrian movements and provide pedestrian friendly environment in Downtown San Diego, California, USA. The Traffic Engineering Department, City of San Diego then requested a focused traffic signal operation study and a signal modification design due to the proposed improvement project to ensure that this proposed project has no significant impacts to the current and near-term future traffic conditions at this intersection (Pitaksringkarn, 2005). It was implemented through PPP (Public Private Partnership). Katz, Okitsu & Associates (KOA) was the leading traffic engineering firm of this project conducting the study and the signal design recommendation of the proposed pedestrian scramble signal project.

5.4 Design Principles of EPP

Introducing EPP in this study is based on the hypothesis as an additional pedestrian phase has a positive correlation to increase efficiency of intersection. In other words, if a

pedestrian phase is introduced it will lead to increase vehicle speed. To examine the hypothesis, traffic speed of different types of vehicles were determined through video recording in three selected intersections. Road width of different dimension of roads was calculated from GIS database prepared by RAJUK in Detailed Area Plan (DAP). If the average vehicle speed is 15 km per hour, it is intended to be increased after introduction of EPP

5.4.1 Design Consideration of EPP

Traffic Volume Survey was conducted by Video recording in 3 intersections for the necessity of achieving the objectives of the study. Applicability of introducing Exclusive pedestrian Phase (EPP) was analyzed in three intersections as Shahbag, Sonargaon, and Newmarket. In order to improve pedestrian movements and provide pedestrian-friendly environment in the intersections of Dhaka, scramble pedestrian phase may be introduced in some selected intersections. Synchro traffic signal analysis is one of the software based method of designing scramble pedestrian phasing. The result from the Synchro traffic signal analysis suggest that the proposed pedestrian scramble signal has no significant impact to the current vehicular traffic operation at the intersection (Pitaksringkarn, 2005).

Pedestrian crossing requirements can be taken care by two ways; by suitable phase design or by providing an exclusive pedestrian phase. It is possible in some cases to allocate time for the pedestrians without providing an exclusive phase for them. For example, consider an intersection in which the traffic moves from north to south and also from east to west. If we are providing a phase which allows the traffic to flow only in north-south direction, then the pedestrians can cross in east-west direction and vice-versa. However in some cases, it may be necessary to provide an exclusive pedestrian phase. In such cases, the procedure involves computation of time duration of allocation of pedestrian phase.

Green time for pedestrian crossing G_p can be found out by,

$$G_p = t_s + d_x/u_p$$

where G_p is the minimum safe time required for the pedestrians to cross, often referred to as the "pedestrian green time", t_s is the start-up lost time, d_x is the crossing distance in metres, and u_p is the walking speed of pedestrians which is about 15th percentile speed. The start-up lost time t_s can be assumed as 4.7 seconds and the walking speed can be assumed to be 1.2 m/s.

Performance measures:

Performance measures are parameters used to evaluate the effectiveness of the design. There are many parameters involved to evaluate the effectiveness of the design and most common of these include delay, queuing, and stops. Delay is a measure that most directly relates the driver's experience. It describes the amount of time that is consumed while traversing the intersection. The Figure 5.5 shows a plot of distance versus time for the progress of one vehicle.

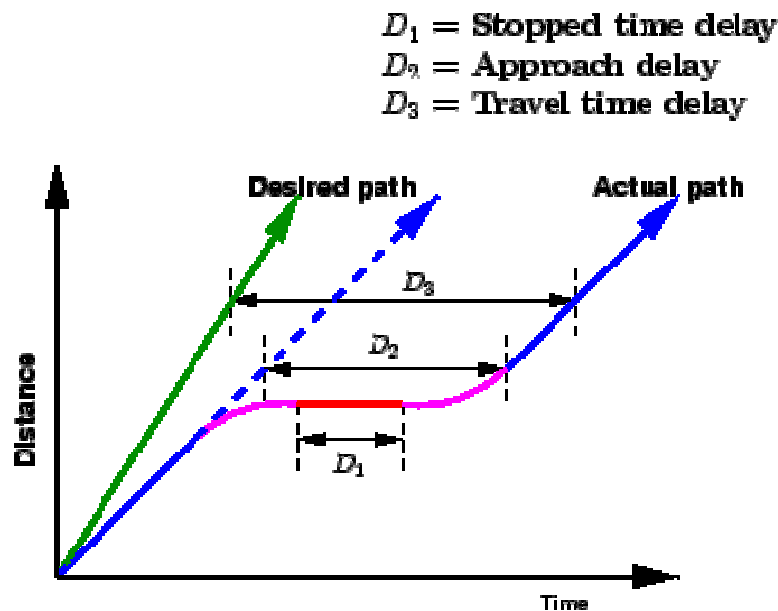


Fig: 5.5 Illustration of delay measures

The desired path of the vehicle as well as the actual progress of the vehicle is shown. There are three types of delay as shown in the figure. They are stopped delay, approach delay and control delay. Stopped time delay includes only the time at which the vehicle is actually stopped waiting at the red signal. It starts when the vehicle reaches a full stop,

and ends when the vehicle begins to accelerate. Approach delay includes the stopped time as well as the time lost due to acceleration and deceleration. It is measured as the time differential between the actual path of the vehicle, and path had there been green signal. Control delay is measured as the difference between the time taken for crossing the intersection and time taken to traverse the same section, had been no intersection. For a signalized intersection, it is measured at the stop-line as the vehicle enters the intersection. Among various types of delays, stopped delay is easy to derive and often used as a performance indicator and will be discussed.

Vehicles are not uniformly coming to an intersection. i.e., they are not approaching the intersection at constant time intervals. They come in a random manner. This makes the modeling of signalized intersection delay complex. Most simple of the delay models is Webster's delay model. It assumes that the vehicles are arriving at a uniform rate. Plotting a graph with time along the x-axis and cumulative vehicles along the y-axis we get a graph as shown in figure. The delay per cycle is shown as the area of the hatched portion in the Figure 5.6.

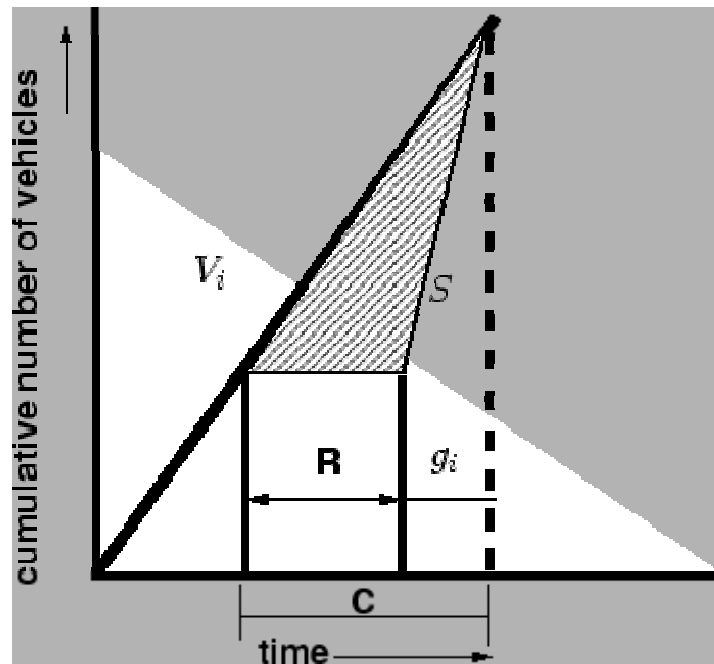


Fig: 5.6 Graph between time and cumulative number of vehicles at an intersection

$$d_i = c/2 (1-g_i/c)^2 / (1 - V_i/S)$$

Webster derived an expression for delay per cycle based on this, which is as follows:

Where g_i is the effective green time, c is the cycle length, V_i is the critical flow for that phase, and S is the saturation flow. Delay is the most frequently used parameter of effectiveness for intersections. Other measures like length of queue at any given time (Q_T) and number of stops are also useful. Length of queue is used to determine when a given intersection will impede the discharge from an adjacent upstream intersection. The number of stops made is an important input parameter in air quality models.

PCU Values:

For the design PCU value taken from Justo and Tuladhar chart. The chart is given to the following Table 5.3

Table 5.3: PCU Values at Signalized Intersection

SL. No.	Organization/Author	TRRL	Justo and Reddy	Bhattacharya And Mandal	Justo and Tuladhar
	Class of Vehicle	PCU values			
1.	Car, Jeep	1.0	1.0	1.0	1.0
2.	Bus	2.25	2.8	2.25 (Single) 2.1 (Double) 1.5 (Min)	2.8
3.	Truck	1.75 (Medium) 2.25 (Heavy)	2.8	2.35	2.8
4.	Auto Rickshaw	0.33	.4	.35	.4
5.	Scooter, Motor Cycle		0.3		0.3
6.	Pedal Cycle		0.35		0.4

Source: Justo and Tuladhar, 1984

Volume Capacity ratio:

For the design purpose volume capacity ratio is taken 0.9 and 0.95 which is near capacity condition. Volume capacity ratio table is given to the following table

Table 5.4: Intersection status criteria for planning

Critical v/c ratio (x cm)	Capacity condition
$X\text{ cm} \leq 0.85$	Under Capacity
$0.85 < x\text{ cm} \leq 0.95$	Near Capacity
$0.95 < x\text{ cm} \leq 1.00$	At Capacity
$x\text{ cm} < 1.00$	Over Capacity

Source: Table 9-14, HCM 1994

5.4.2 Conditions of Exclusive pedestrian Phase

In a recent study on exclusive pedestrian phase conducted by Australian Government. suggests that Pedestrian signals may be configured to provide an exclusive pedestrian phase whereby all vehicle movements in all directions across the intersection are stopped and pedestrians are allowed to cross in all designated directions, when all of the following criteria are met:

- None of the roads is a declared highway or main road
- The intersection is in a central business area or shopping area
- An equivalent or better alternative route is available for through traffic to avoid the intersection if it so desires
- The existing signal intersection is operating in a simple 2 traffic phase mode
- During any 4 periods (consecutive or non-consecutive) of 1 hour each, on any one weekday, more than 200 pedestrians cross in all directions per hour and during the same hours, more than 400 vehicles turn within the intersection.

Toronto established the following criteria in introducing EPP (Bissessar, R. et al, 2010).

- High pedestrian volumes average > 3,000 pedestrians per hour for an eight hour period.

- Moderate pedestrian volumes average >2000 pedestrians per hour for an eight hour period.
- High turning vehicle volumes > 35 % of total vehicular approach volume.
- High concentration of pedestrian-vehicle collisions > three left-turn and right-turn collisions where pedestrians had the right-of way over a three year period
- There is a desire by at least 15% of pedestrians to cross diagonally
- Unusual intersection geometry (five or more legs) that precludes normal pedestrian crossing operation

5.5 Reasons of Selecting ‘Newmarket Intersection’ for Exclusive pedestrian Phase

On the basis of before mentioned criterions it was examined if it is possible to introduce exclusive pedestrian phase in the selected intersections. One of the studied intersections namely “New market intersection” was prioritized to introduce because it fulfils all the requirements mentioned above because:

- It is situated on Mirpur road which is not a declared highway or main road
- The intersection is situated near one of the most important shopping area namely new market because people from different parts of the city visit this area for shopping everyday
- An equivalent or better alternative route like elephant road is available for diverting through traffic
- This study reveals that about 6218 pedestrian traffic per hour generated in an around the newmarket intersection per hour in a peak period which fulfils the traffic volume requirement.

5.5.1 Introducing EPP at New Market Intersection

Saturation Flow rate, $s=3575$ (Hadiuzzaman, 2008)

Lost time Per Phase =2.4 sec

Amber time is =3 sec

Assume v/c ratio =0.9

Saturation Headway, $h = 3600/s = 3600/3575 = 1.01$

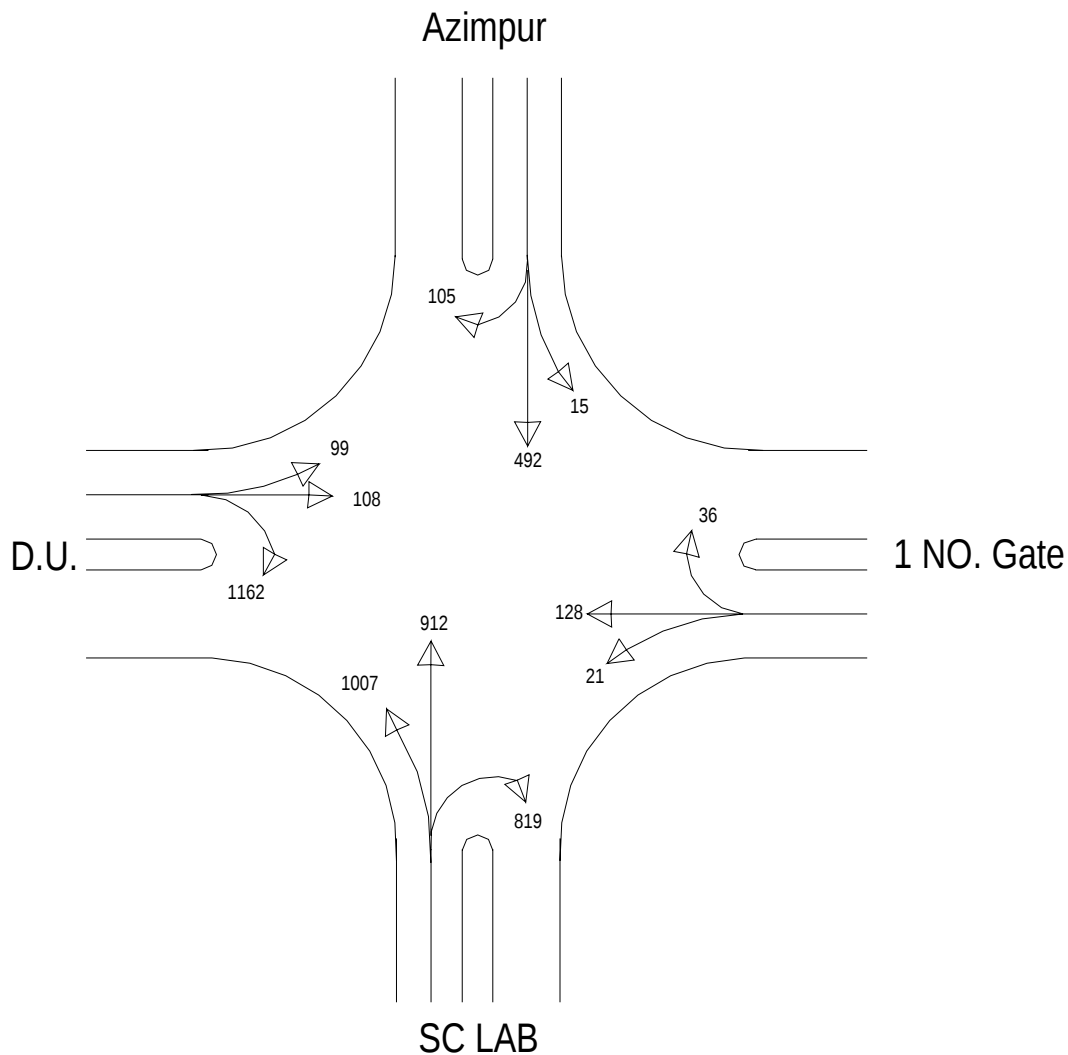


Fig: 5.7 One Hour Traffic Volume Data of New market Intersection

Fig: 5.7 shows the traffic volume data of New market intersection from this figure the critical lane volume (highest lane volume) is taken for summation to get sum of critical lane volume V_{ci} .

Sum of critical lane volume is the sum of maximum lane volumes in each phase
 $V_{ci} = 1162 + 674 + 128 + 1007$

$$= 2971$$

Cycle length can be found out from the equation $C = \frac{N*L*(v/c)}{(v/c - v_c/s_i)}$

Where

N = no. of phase

L = Lost time per Phase

v/c = Critical volume capacity ratio

$$C = \frac{4*2.4*0.9}{(0.9 - 2971/3575)}$$

$$C = 125.3 \text{ sec}$$

The effective green time can be found out as

$$G_i = V_{ci}/V_c (C-L)$$

$$\begin{aligned} \text{The effective green time} &= (125.3 - 2.4*4) \\ &= 115.7 \text{ sec} \end{aligned}$$

Green splitting for different phase can be found out as

$$G_1 = 115.7 * 1162/2971 = 45.25 \text{ sec}$$

$$G_2 = 115.7 * 1007/2971 = 39.31 \text{ sec}$$

$$G_3 = 115.7 * 128/2971 = 5 \text{ sec}$$

$$G_4 = 115.7 * 674/2971 = 26.24 \text{ sec}$$

Similarly actual green time for phase 1, $G_1 = 45.25 - 3 + 2.4 = 44.65 \text{ sec} \approx 45 \text{ sec}$

Actual green time for phase 2, $G_2 = 39.31 - 3 + 2.4 = 38.71 \text{ sec} \approx 39 \text{ sec}$

Actual green time for phase 3, $G_3 = 5 - 3 + 2.4 = 4.4 \text{ sec} \approx 5 \text{ sec}$

Actual green time for phase 4, $G_4 = 26.24 - 3 + 2.4 = 25.64 \text{ sec} \approx 26 \text{ sec}$

Pedestrian time can be found out from

$$G5 = 4 + 32.01 / 1.2 = 30.25 = 31 \text{ sec}$$

$$\begin{aligned} \text{The cycle length} &= 45 + 5 + 26 + 39 + 31 + 12 \\ &= 158 \text{ sec} \end{aligned}$$

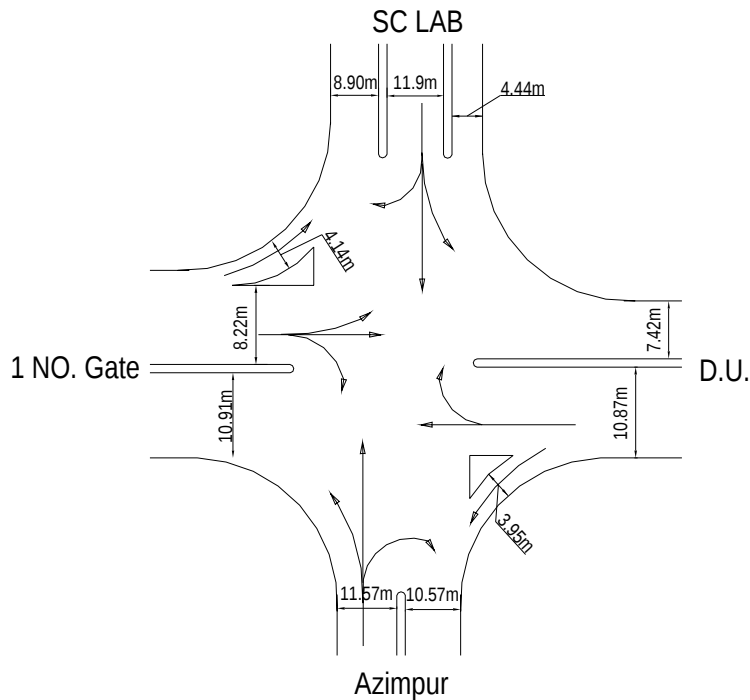
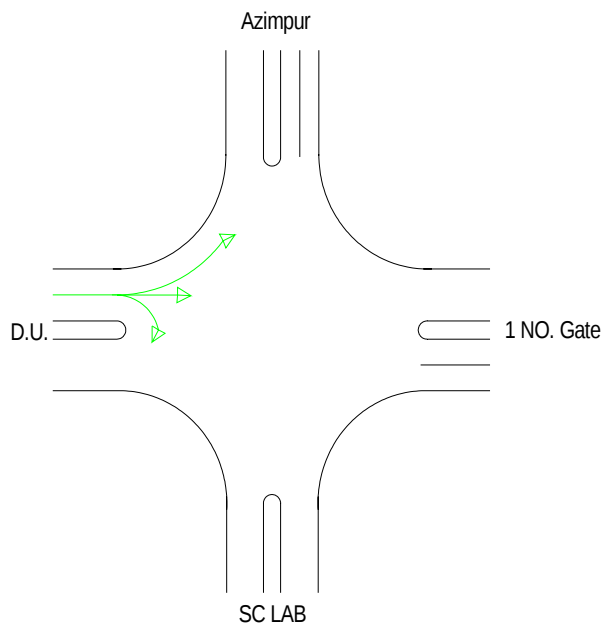
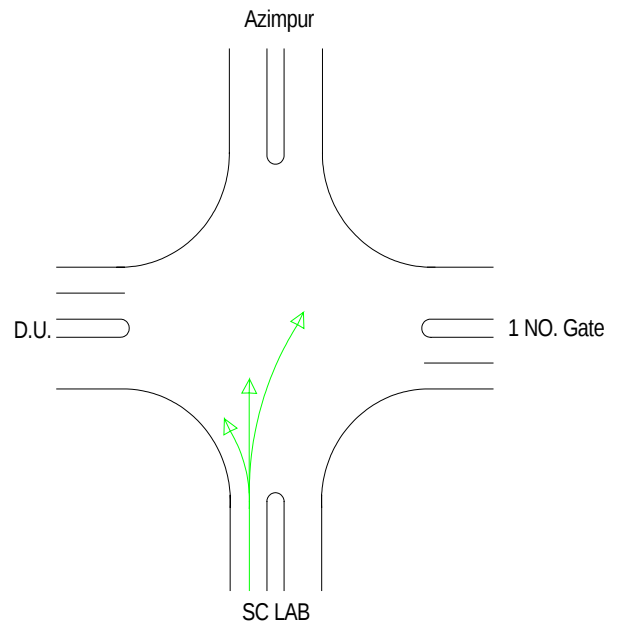


Fig: 5.8 Geometric Features of New market Intersection

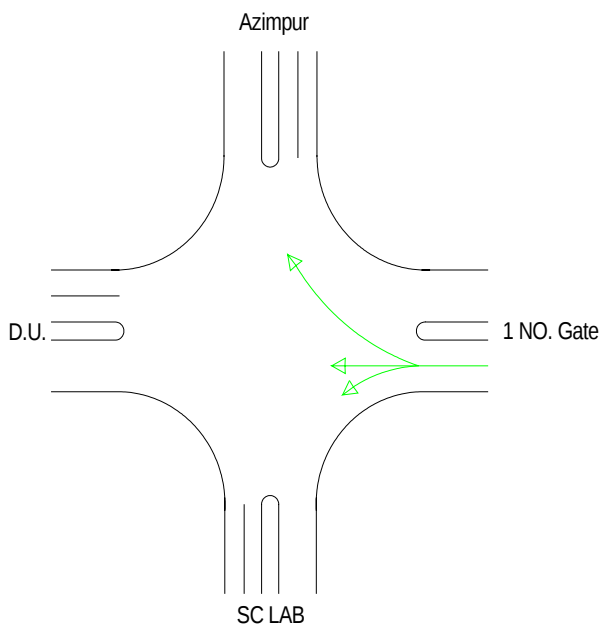
Fig: 5.8 shows geometric feature of Newmarket intersection from which road widths are taken to get pedestrian crossing time of the intersection diagonally. Because in the concept of exclusive pedestrian phase pedestrian can move all direction including diagonally. As crossing time of diagonal distance is high so this time is taken for the experiment.



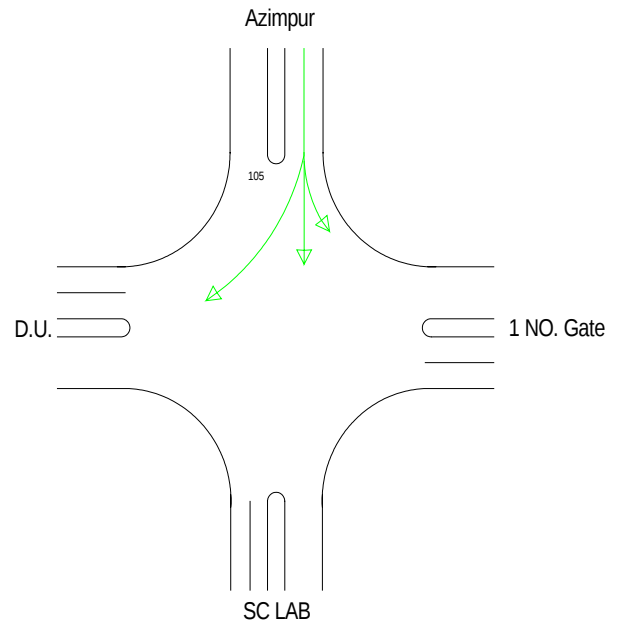
Phase-1
FIG: NEW MARKET
INTERSECTION



Phase-2
FIG: NEW MARKET
INTERSECTION



Phase-3
FIG: NEW MARKET
INTERSECTION



Phase-4
FIG: NEW MARKET
INTERSECTION

Fig: 5.9 Phase Plan for New Market Intersection

Fig: 5.9 shows the phase plan of Newmarket intersection, phase is started in anti-clock wise direction. Phase-1 shows vehicle move from Dhaka University to all direction and get 45 second vehicle green which is shown in the Fig: 5.10. Phase-2 shows vehicle move from science laboratory to all direction and get 39 second to move. Phase-3 shows Newmarket 1no.Gate direction to all direction and get only 5 second vehicle green time. Phase-4 shows vehicle move from Azimpur direction to all direction and get 26 second vehicle green time. At last Phase-5 which is pedestrian green time to cross the intersection. Here pedestrian green time is 27 second and total cycle is 158 second. In Fig: 5.10 red colour represent waiting time and yellow colour represent amber time.



Fig: 5.10 Signal Timing Diagram for Newmarket Intersection

5.5.2 Delay Measurement at the Newmarket Intersection by Webster Method

Delay at intersection in D.U to SC Lab direction can be found from the equation

$$D = \frac{158/2 \{1 - (45 - 2.4 + 3)/158\}^2}{(1 - 1162/3575)}$$

$$= 59.23 \text{ sec/cycle}$$

Delay at intersection in SC Lab to Azim pur direction can be found from the equation

$$D = \frac{158/2 \cdot \{1 - (39 - 2.4 + 3)/158\}^2}{(1 - 912/3575)}$$

$$= 59.55 \text{ sec/cycle}$$

Delay charts Before and After use EPP are given in Appendix-5

5.6 Reasons of Selecting ‘Shahbag Intersection’ for Exclusive pedestrian Phase

On the basis of before mentioned criterions it was examined if it is possible to introduce exclusive pedestrian phase in the selected intersections. One of the studied intersections namely “Shahbag’ was prioritized to introduce because it fulfils all the requirements mentioned above because:

- It is situated on Kazi Nazrul Islam Avenue which is a major road but intersects Road of Dhaka University
- The intersection is situated near one of the most important Institutional area consisting Hospitals, Universities, Parks etc
- An equivalent or better alternative route is not available for diverting through traffic
- This study reveals that about 7140 pedestrian traffic per hour generated in an around the Shahbagh intersection per hour in a peak period which fulfils the traffic volume requirement

5.6.1 Introducing EPP at Shahbagh Intersection

A high number of conflicts between pedestrian and vehicles were occurring at busy intersections like Shahbagh .Many people gather here because it is a place of two reknowned hospital named BSMMU (Bangobandhu Sheikh Mujib Medical University) and Ibrahi Cardiac Medical College, Dhaka University, National Museum and etc. However, the daytime population is huge, mostly concentrated in the Business District. Daytime pedestrian activity is very heavy in this area Business District due to the concentration of businesses and services and the high volume of tourists visiting the area around famous Ramna Park, Shishu Park, Sahrawardi Uddan. The primary concern for this area is the high number of conflicts between pedestrians and vehicles at the intersection, especially during holidays and peak tourist time. Large pedestrian flows were

blocking crosswalks to turning traffic during the entire green signal phase. A review of the accident history revealed several reported vehicle-pedestrian accidents.

Saturation Flow rate, $s=5890$

Assume:

Lost time Per Phase =2.4 sec

Amber time is =3 sec

Assume, v/c ratio =0.95 (Near Capacity)

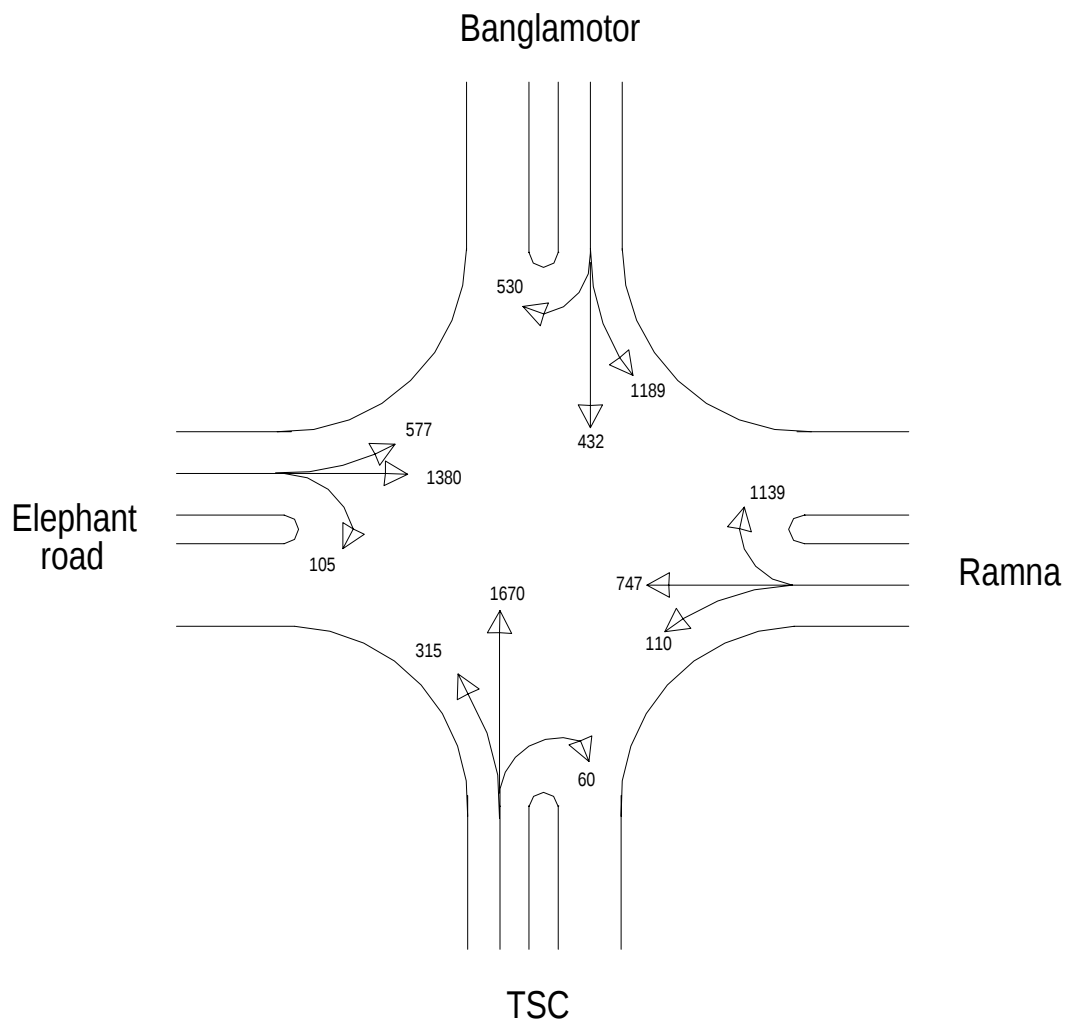


Fig: 5.11 One hour Traffic Volume Data of Shahbag Intersection

Fig: 5.11 shows the traffic volume data of Shahbag intersection from this figure the critical lane volume (highest lane volume) is taken for summation to get sum of critical lane volume V_{ci} .

Sum of critical lane volume is the sum of maximum lane volumes in each phase
 $V_{ci} = 1380 + 1670 + 1139 + 1189$ (From Fig: 5.11)
 $= 5378$

Cycle length can be found out from the eq $C = \frac{N * L * (v/c)}{(v/c - v_{c/si})}$

Where

N = no. of phase

L = Lost time per Phase

v/c = Critical volume capacity ratio

$$C = \frac{4 * 2.4 * 0.95}{(0.95 - 5378/5890)}$$

$$C = 246.97 \text{ sec}$$

The effective green time can be found out as

$$G_i = V_{ci} / V_c (C - L)$$

$$\begin{aligned} \text{The effective green time} &= (246.97 - 2.4 * 4) \\ &= 237.37 \text{ sec} \end{aligned}$$

Where L is the lost time for that phase $= 2.4 * 4$

Green splitting for phase 1 can be found out as

$$G_1 = 237.37 * 1670 / 5378 = 73.7 \text{ sec}$$

Green splitting for phase 2 can be found out as

$$G_2 = 237.37 * 1139 / 5378 = 50.27 \text{ sec}$$

Green splitting for phase 3 can be found out as

$$G3 = 237.37 * 1189 / 5378 = 52.47 \text{ sec}$$

Green splitting for phase 4 can be found out as

$$G4 = 237.37 * 1380 / 5378 = 60.90 \text{ sec}$$

Similarly actual green time for phase 1, $G1 = 73.7 - 3 + 2.4 = 73.1 \text{ sec} \approx 73 \text{ sec}$

actual green time for phase 2, $G2 = 50.27 - 3 + 2.4 = 49.67 \text{ sec} \approx 50 \text{ sec}$

actual green time for phase 3, $G3 = 52.47 - 3 + 2.4 = 51.87 \text{ sec} \approx 52 \text{ sec}$

actual green time for phase 3, $G4 = 60.90 - 3 + 2.4 = 60.3 \text{ sec} \approx 60 \text{ sec}$

Pedestrian time can be found out from

$$G5 = 4 + 64.63 / 1.2 = 57.85 \approx 58 \text{ sec (From Fig: 5.12)}$$

The total cycle length $= 73 + 50 + 52 + 60 + 58 + 12 = 305 \text{ sec}$

Fig: 5.12 shows geometric feature of Shahbag intersection from which road widths are taken to get pedestrian crossing time of the intersection diagonally. Because in the concept of exclusive pedestrian phase pedestrian can move all direction including diagonally. As crossing time of diagonal distance is high so this time is taken for the experiment.

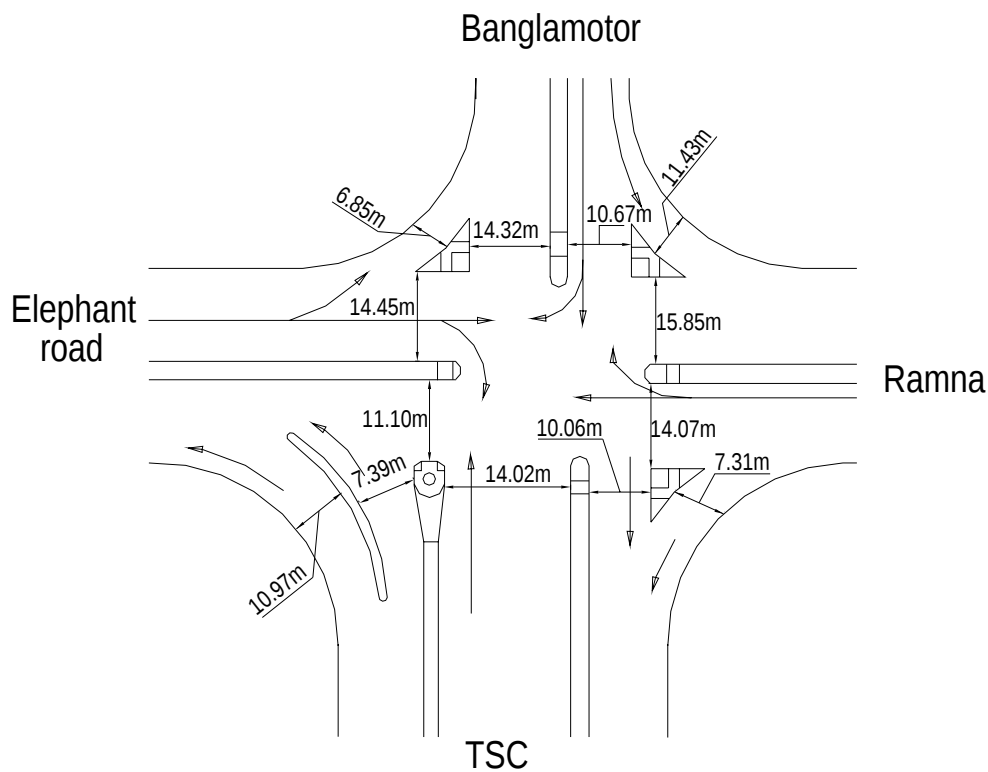


Fig: 5.12 Geometric Features of Shahbagh Intersection

Fig: 5.13 shows the phase plan of Shahbagh intersection, phase is started in anti-clock wise direction. Phase-1 shows vehicle move from TSC to all direction and get 73 second vehicle green which is shown in the Fig: 5.14. Phase-2 shows vehicle move from Ramna to all direction and get 50 second to move. Phase-3 shows Banglamotor direction to all direction and get 52 second vehicle green time. Phase-4 shows vehicle move from Elephant road direction to all direction and get 60 second vehicle green time. At last Phase-5 which is pedestrian green time to cross the intersection. Here pedestrian green time is 54 second and total cycle is 305 second. In Fig: 5.14 red colour represent waiting time and yellow colour represent amber time.

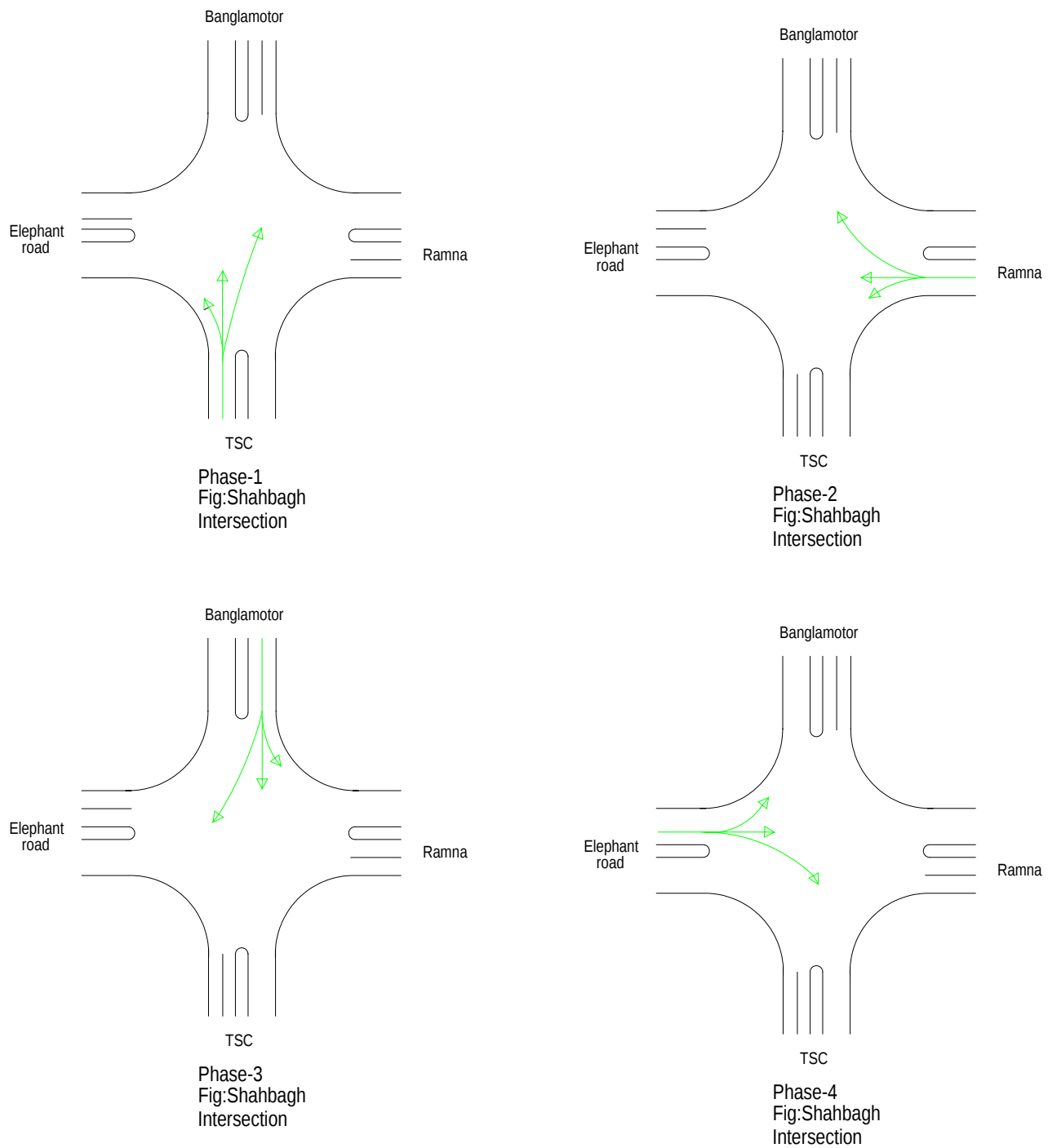


Fig: 5.13 Phase Plan for Shahbagh Intersection

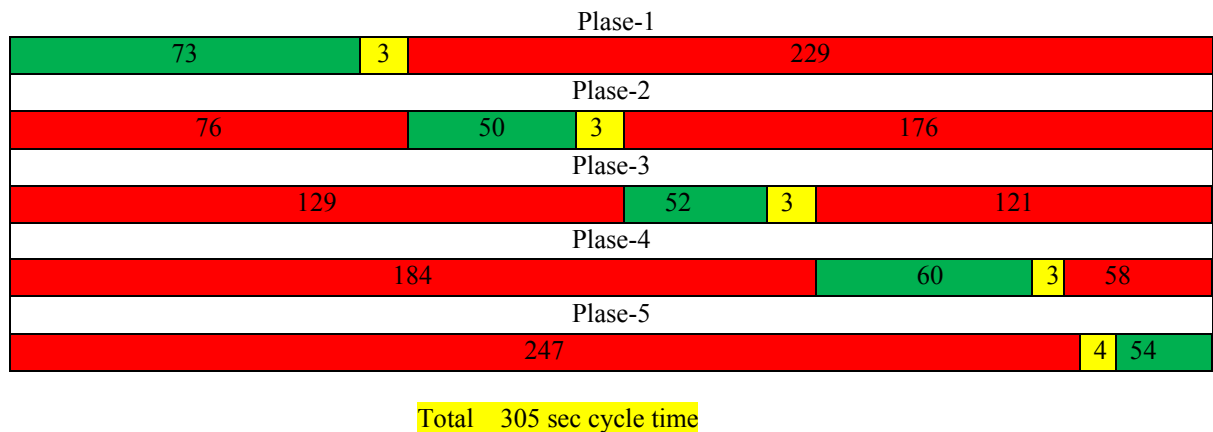


Fig: 5.14 Signal Timing Diagram for Shahbagh Intersection

5.6.2 Delay Measurement at Shahbag intersection by Webster Method

Delay at intersection in Elephant road to Ramna direction can be found from the equation

$$D(en) = \frac{305/2 \cdot \{1 - (60 - 2.4 + 3)/305\}^2}{(1 - 1380/5890)}$$

$$= 127.88 \text{ sec/cycle cc}$$

Delay at intersection in TSC to Banglamotor direction can be found from the equation

$$D(en) = \frac{305/2 \cdot \{1 - (73 - 2.4 + 3)/305\}^2}{(1 - 1670/5890)}$$

$$= 122.52 \text{ sec/cycle cc}$$

Delay charts Before and After use EPP are given in Appendix-5

5.7 Reasons of Selecting 'Sonargaon Intersection for Exclusive pedestrian Phase

A high number of conflicts between pedestrian and vehicles were occurring at busy intersections like Sonargaon. Many people gather here because it is one of the most busy commercial area. The primary concern for this area is the high number of conflicts between pedestrians and vehicles at this intersection. A review of the accident history revealed several reported vehicle-pedestrian accidents.

5.7.1 Introducing EPP at Sonargaon Intersection

Saturation Flow rate, $S_i=9160$

Assume:

Lost time Per Phase =2.4 sec

Amber time is =3 sec

Assume, v/c ratio =0.90 (Near Capacity)

Sum of critical lane volume is the sum of maximum lane volumes in each phase

$$\begin{aligned}\sum V_{ci} &= 3765 + 961 + 439 \\ &= 5165\end{aligned}$$

$$(V_c / S_i) = 5165 / 9160 = 0.56$$

Cycle length can be found out from the eq $C = \frac{N * L * (v/c)}{(v/c - v_c/s_i)}$

Where

N = no. of phase

L = Lost time per Phase

v/c = Critical volume capacity ratio

$$C = \frac{4 * 2.4 * 0.9}{(0.9 - 0.56)}$$

$C = 25.41 \text{ sec}$ (The result is abnormal for this intersection)

Hence the traffic flowing from north to south can be allowed to flow into three lanes
 $3765/3=1255$ vehicle per lane

so the sum of critical lane volume= $1255+961+439=2656$ (values are taken From Fig:5.15)

and, Saturation flow rate per lane can be found = $9160/3 = 3053.33$

Now cycle time can be found out = $\frac{3*2.4*0.9}{(0.9-2656/3053.33)}$
= 215 sec
= 3 min 35 sec

the effective green = $215-3*2.4 = 207.8 \text{ sec}$

The green splitting into for the phase-1 can be found out as
 $g_1 = (3765*207.8)/5165 = 151.47$

The green splitting into for the phase-2 can be found out as
 $g_2 = (961*207.8)/5165 = 38.66$

The green splitting into for the phase-3 can be found out as
 $g_3 = (439*207.8)/5165 = 17.66$

The actual green time for Phase-1, $G_1 = 151.47-3+2.4 = 150.87 \text{ sec} \approx 151 \text{ sec}$

The actual green time for Phase-1, $G_2 = 38.66-3+2.4 = 38.06 \text{ sec} \approx 38 \text{ sec}$

The actual green time for Phase-1, $G_3 = 17.66-3+2.4 = 17.06 \text{ sec} \approx 18 \text{ sec}$

Pedestrian time can be from as $G_p = 4+60/1.2 = 54 \text{ sec}$

The total cycle time = $151+38+18+9+54 = 270 \text{ sec}$

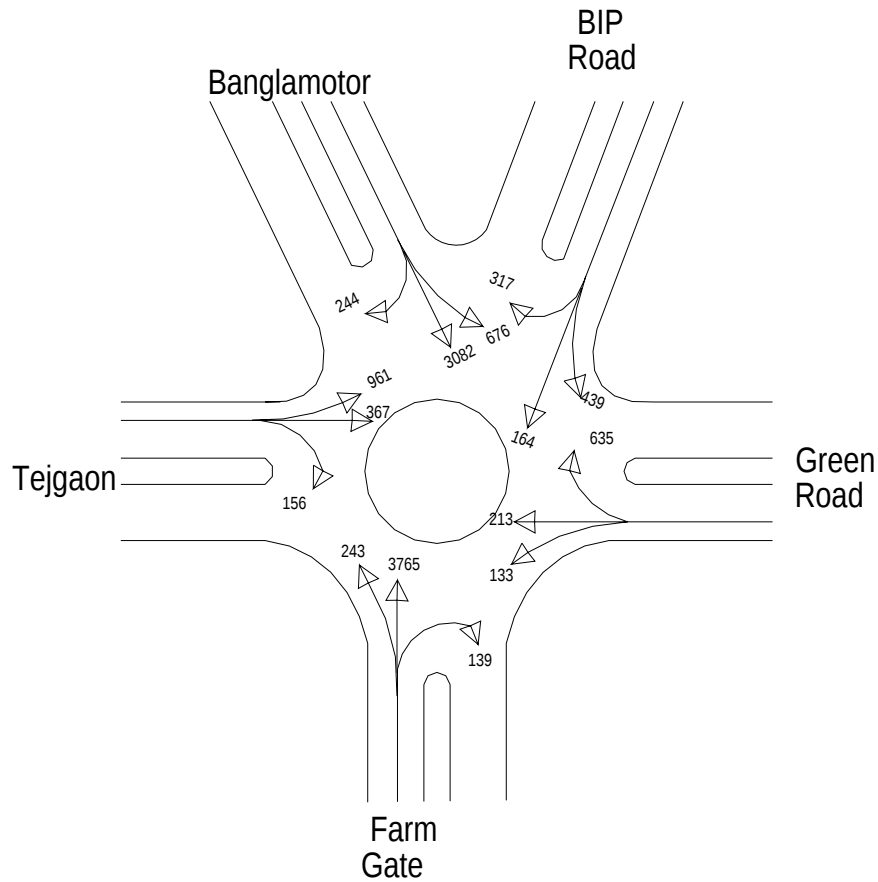


Fig: 5.15 One hour Traffic Volume Data of Sonargaon Intersection

Fig: 5.15 shows the traffic volume data of Sonargaon intersection from this figure the critical lane volume (highest lane volume) is taken for summation to get sum of critical lane volume V_{ci} .

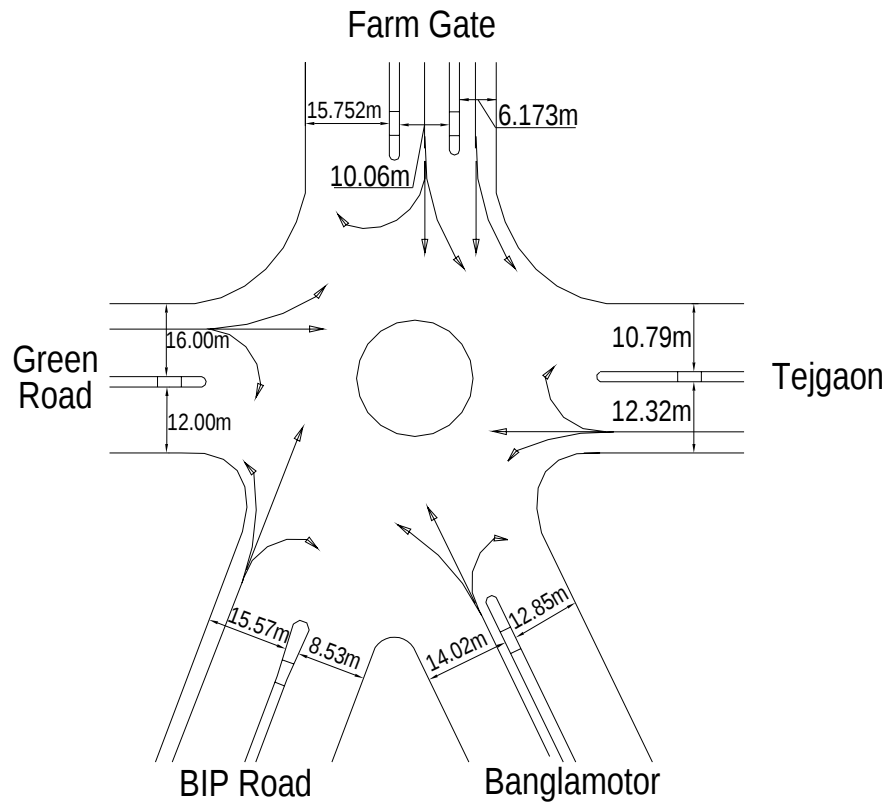


Fig: 5.16 Geometric Features of Sonargaon Intersection

Fig: 5.16 shows geometric feature of Sonargaon intersection from which road widths are taken to get pedestrian crossing time of the intersection diagonally. Because in the concept of exclusive pedestrian phase pedestrian can move all direction including diagonally. As crossing time of diagonal distance is high so this time is taken for the experiment. But Sonargaon intersection is a roundabout three road widths crossing time are taken for the calculation.

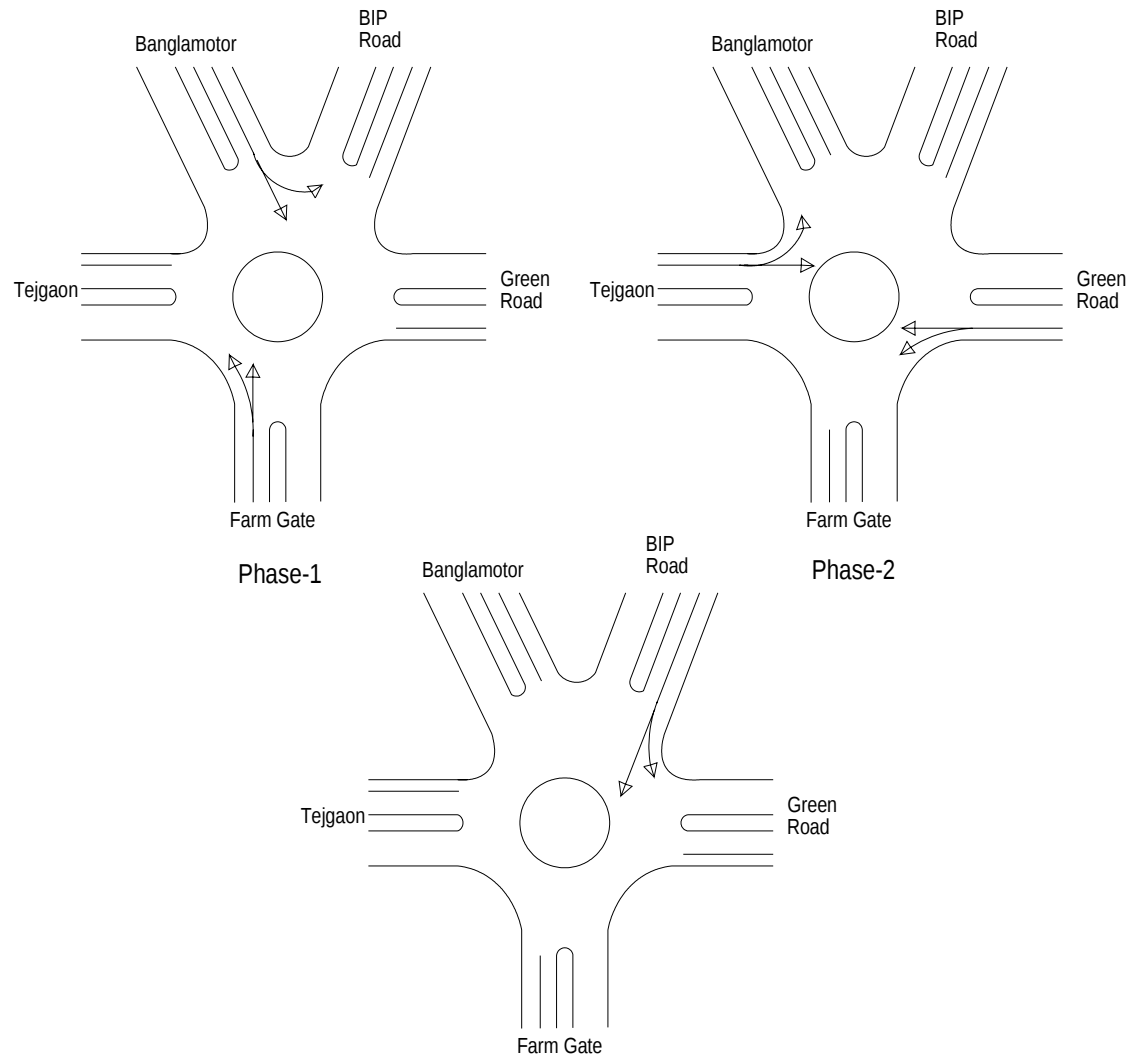


Fig: 5.17 Phase Plan for Sonargaon Intersection

Fig: 5.17 shows the phase plan of Sonargaon intersection, phase is started in anti-clock wise direction. Phase-1 shows vehicle move from Banglamotor to all direction and Farmgate to all direction and get 151 second vehicle green which is shown in the Fig:

5.18. Phase-2 shows vehicle move from Tejgaon to all direction and Green road to all direction and get 38 second green time to move. Phase-3 shows BIP road direction to all direction and get 18 second vehicle green time. At last Phase-5 which is pedestrian green time to cross the intersection. Here pedestrian green time is 50 second and total cycle is 270 second. In Fig: 5.18 red colour represent waiting time and yellow colour represent amber time.

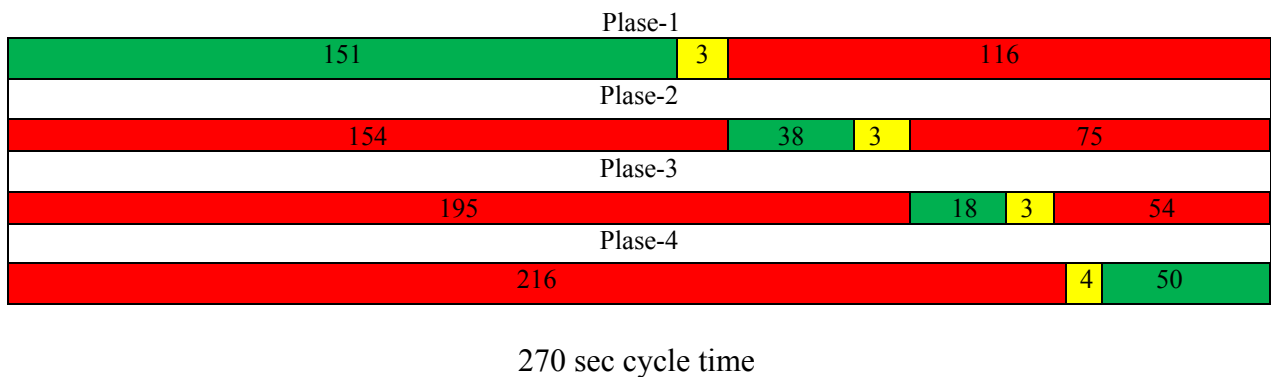


Fig: 5.18 Signal Timing Diagram for Sonargaon Intersection

5.7.2 Delay Measurement at Sonargaon intersection by Webster Method

Delay at intersection in Farm gate to Banglamotor direction can be found from the equation

$$D = 270/2 \frac{\{1 - (151 - 2.4 + 3)/270\}^2}{(1 - 3765/9160)}$$

$$= 44.07 \text{ sec/cycle}$$

Delay at intersection in Tejgaon to Green Road direction can be found from the equation

$$D = 270/2 \frac{\{1 - (38 - 2.4 + 3)/270\}^2}{(1 - 367/9160)}$$

$$= 103.29 \text{ sec/cycle}$$

5.8 Increase Intersection Efficiency by EPP

A recent study on “Pedestrian Scramble Crossings” in Toronto reveals that approximately two thirds of the pedestrians believe that EPP would not have a negative impact on traffic flow and streetcar operations (Bissessar, R. et al, 2010). In this study, from GIS map and video record survey it is known that the vehicle speed of the three selected intersection is near about 16 kmph for Newmarket and Shahbag intersection and 17 kmph for Sonargaon intersection. If the intersections are provided with EPP, indiscriminate movement of pedestrian will be reduced and safety will be ensured. Thus it is possible to increase vehicle speed and introducing of EPP will impose no negative impact on vehicular flow in those intersections. For an instance, one intersection has one phase of 45 sec where vehicle speed is 16 kmph. If the vehicle speed is increased by 18 to 20 kmph then the required time for the cycle will be less by 5 to 9 sec for the phase duration of 45 sec. By this way it may be possible to decrease cycle time.

CHAPTER: SIX

CONCLUSION AND RECOMMENDATIONS

6.1 Conclusion

Generalized situations of pedestrian facilities are very poor in Dhaka city. The study reveals that there is absence of visible cross marking in 70%, foot over bridge in 73%, Refuge Island in 30%. The situation may be over come by providing more pedestrian facilities in the intersections of Dhaka city.

After studied some generalized intersections illegal and unsafe crossing is found in most of the intersections which is induced to face any fatal accident any time. Illegal crossings are found by the pedestrian of 12% in Shahbag intersection, 48% in Maghbazar intersection, 16% in Newmarket intersection, 26% in Elephant road intersection, 21% in Sonargaon intersection and 13% in Banglamotor intersection. This situation symbolized very chaotic situation. The situation must be over come by introducing strong imposition to use foot over bridge and cross marking. Awareness generation is needed among pedestrian vehicle users citizens and all the concerned stake holders about safe road crossing and pedestrian safety. Scramble pedestrian phase is a tool of safe pedestrian crossing which is successfully being used in different cities of the world. In Dhaka city it can be introduced in pilot basis in some selective intersections where pedestrian traffic volume is high. This Study proposed exclusive pedestrian phase at some intersections in Dhaka city and signal designed has been hypothetically modeled incorporating EPP in two intersections of Dhaka city.

Pedestrian crossing behavior depends on the destination, age, education, physical condition and overall awareness of the pedestrian. The issues associated with pedestrian crossing activities generally create considerable emotional concern within the community, especially when the community is reacting to an incident involving pedestrian injury. Pedestrian crossing safety relies on the judgment exercised by pedestrians and drivers. To interact safely requires an exchange of information between

the pedestrian and the motorist. Although traffic control devices can help to promote an exchange of information, educating pedestrians and drivers is paramount to providing for a safe operation. Provision of visible cross marking must be installed in all the intersections. Considering the high density of pedestrian traffic all over the city, it should be provided to ensure safe pedestrian crossing. Median island with median barrier must be provided in all the intersections to ensure safe pedestrian crossing. Street lighting around the crossing should be adequate so that cross marks are easily captured by the vehicle drivers to have stopping sight distance to avoid collision. Management of existing physical infrastructure must be enhanced to enable more effective use of crosswalks. It is provided with better road markings, signs, traffic signals, canalization at intersections, turn restrictions and separation barriers, space for bus stops, and parking or waiting areas for public transport vehicles (buses, rickshaws, auto-rickshaws, taxis, etc.). Pedestrian crossing should be considered carefully in traffic engineering and planning of the intersections and mid blocks.

Walking should be recognized as one of the dominant means of travel all over Dhaka city and facilities should be provided for the pedestrians on priority basis. Pedestrian crossing safety should be ensured based on traffic management, intersections and midblock design considerations, intersection geometry, signal designing, pedestrian facilities as signs, visible cross marking, existence of grade separated crossing facilities like over pass, underpass and many other factors.

Pedestrian walkways that are either non-existent or in poor physical condition should be improved so that it is not blocked by various obstacles and pedestrians are not forced to walk on the road. It is necessary to remove inappropriate and illegal non-transport related activities from the public right-of-way to reclaim the full potential capacity of the existing road. In some cases this may involve the need to help relocate or establish alternative sites for such activities. Initiatives should be taken to improve the ability of road users (motorists and pedestrians alike) to adopt behavioral patterns which lead to more efficient and safer transport services. Programs should be taken to alter community attitudes and invoke a greater willingness to accept better discipline by all users and

providers of the transport services. Enforcement of traffic rules is needed to ensure a greater compliance with community desired road user behavior. Enforcement actions can involve formal policing as well as informal pressure on individuals to adopt community norms of behavior and should include the involvement of community leaders. During pedestrian crossing vehicles are found to run with full speed which is a dangerous threat to pedestrian safety must be stopped. All the vehicles should be enforced properly to reduce speed at the zebra crossing in the entire semi automated signalized intersections.

The issue of safety must receive a high priority in analyzing pedestrian crossing behavior and future planning and designing of the intersections. Policies should be formulated to Implement EPP through PPP as it is challenging to implement and bear all the cost of implementation of EPP by the Government alone. It can be an implementation strategy through Public-Private Partnership (PPP) for introducing EPP in intersections of Dhaka city where it will be feasible. Traffic control devices can help to promote an exchange of information, educating pedestrians and drivers is paramount to providing for a safe operation.

The pedestrian scramble signal will allow a pedestrian phase to be serviced exclusively. No vehicular traffic phases will be allowed to receive service during the pedestrian scramble phase. Improved pedestrian safety at intersections should be ensured through coordination among public authorities, professional engineers, media, education experts and vehicle designers to reduce both the number and severity of pedestrian collisions.

6.2 Recommendations

The following are some recommendations provided considering holistic thinking to facilitate safe pedestrian and future transportation policy making:

- Exclusive pedestrian Phase may be introduced in some selected intersections on pilot basis to improve pedestrian movements and provide pedestrian-friendly

environment. It can be introduced where pedestrian traffic volume is high and often followed pedestrian crossing haphazardly which reduces vehicle speed.

- Exclusive pedestrian Phase (EPP) may be introduced which will reduce vehicular delay in the intersections. Intersections such as in and around shopping areas, institutional zones are rushed with higher volume of pedestrian traffic and vehicle green time is affected due to haphazard crossing making cordons may be provided with EPP.
- Pedestrian movements may be incorporated in the various phasing schemes. At locations with heavy pedestrian volumes and heavy turning movements, it may be desirable to provide an exclusive phase for pedestrians.
- Illegal parking near the cross marks which obstructs pedestrian crossing and should be stopped.
- Pedestrians intended to avoid grade separated means of crossing for saving time and physical labour should be prohibited through legal actions against them.
- At grade crossing among the pedestrians should not be allowed randomly due to heavy traffic rush in most of the intersections because of high population density and increased volume of traffic in Dhaka city.
- A recommended sample of signal has been added in the annex A2 for pilot project of EPP in Dhaka city
- It can be stated that introduction of exclusive pedestrian signal phasing in the major business and shopping areas of Dhaka city will be low cost and effective tool to improve safety and reduce the potential for automobile and pedestrian conflicts and may also increase efficiency of the intersections.

6.3 Limitations:

- The study does not cover deep analysis on signal designing and traffic management system for the studied area.
- Such a study requires financial and human resources to conduct extensive study. But due to resource and time constraint it limits to conduct more comprehensive study.
- It had not possible to conduct land use and traffic interaction for more analysis on the selectivity of the intersections to propose EPP.

6.4 Future Scope:

It poses enormous potentials to be further studied and recommend best options for selection of the intersection to introduce EPP and recommendation for signal designing in context of Dhaka City. Such research may enrich the quality of traffic management system for the worthy traffic congested city like Dhaka.

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Annex-1

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
1	Mir pur-10 (Goal Chakkar)	4-way	1.yes 2.yes 3.yes 4.yes	yes	yes	yes	no	yes
2	Mirpur -1 (sony hall)	3-way (Tee)	1.no 2.no 3.no	no	yes	yes	no	no
3	Mirpur -1	3-way (Tee)	1.no 2.no 3.no	1.yes 2.yes 3.yes	no	yes	no	yes
4	Mazar road (gabtoli)	3-way (Tee)	1.no 2.no 3.no	no	1.yes 2.yes 3.yes (broken)	yes	no	yes
5	Darussalam (TTC)	3-way (Tee)	1.no 2.no 3.no	no	1.yes 2.yes 3.yes	yes	no	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
6	Shamoli (cinema hall))	3-way (Tee)	1.no 2.no 3.no	1.yes 2.no 3.no	1.no 2.no 3.yes	yes	no	yes
7	Shishumella (Shamoli)	3-way (Tee)	1.no 2.no 3.no	no	1.yes 2. yes 3. yes	yes	no	yes
8	College gate	3-way (Tee)	1.no 2.no 3.no	no	1.yes 2.no 3.no	yes	no	yes
9	Gono Bhaban	4-way (Cross)	1.yes 2.yes 3.yes 4.no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
10	Asad Gate	3-way (Tee)	1.yes 2.no 3.no	1.no 2. yes 3.no	1.yes 2.no 3.no	yes	no	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
11	Manikmiah (avenue))	3-way	1.yes 2.yes 3.yes	no	1.yes 2.yes 3.yes	yes	no	yes
12	Dhanmondi -27	3-way	1.yes 2.no 3.no	no	1.yes 2.yes 3.yes	no	no	no
13	Russel Square	3-way	1.yes 2.yes 3.no	no	1.yes 2.yes(b) 3.no	yes	no	yes
14	Dhanmondi -10	3-way	1.yes 2.yes 3.yes	no	1.yes 2.no 3.no	no	no	yes
15	Dhanmondi -7	3-way	1.no 2.no 3.no	no	1.yes 2.no 3.no	no	no	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
16	Dhanmondi -6	4-way	1.no 2.no 3.no 4.no	no	1.yes 2.no 3.no 4.no	yes	no	Yes (2 direction)
17	Science Lab	3-way	1.no 2.no 3.no	Yes (Cover 3 direction)	no	yes	no	yes
18	Azimpur	4-way	no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
19	Polshi	4-way	1.yes 2.no 3.no 4.no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
20	Doel Chattar	4-way	1.yes 2.no 3.yes 4.no	no	1.yes 2. no 3.no 4.no	no	no	no

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

S.L No.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
21	Carjon Hall	4-way	1.yes 2.yes 3. no 4. no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
22	Zero Point	4-way	1.yes 2.yes 3.yes 4.yes	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
23	Paltan More	4-way	1.yes 2.yes 3.yes 4.no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
24	Golapshah Mazar	4-way	1.no 2.no 3.no 4.no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
25	Jagannath University	3-way (Y)	1.no 2.no 3.no	no	1.yes 2.no 3.no	no	1.yes 2.no 3.no	no

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
26	Dholaikhal	3-way	1.no 2.no 3.no	no	no	yes	no	no
27	English Road	3-way	1.yes 2.no 3.no	no	1.yes 2.yes 3.yes	yes	no	yes
28	Katabon	4-way	1.yes 2.yes 3.yes	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
29	Bata More	4-way	1.no 2.no 3.no 4.no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
30	Panthopath /Greenroad	4-way	1.yes 2.yes 3.yes 4.yes	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
31	Bijoy smarani (Aeroplane)	4-way	1.yes 2.no 3.no 4.no	no	1.yes 2.yes 3.yes 4.no	yes	no	yes
32	Bijoy smarani (Rangs)	4-way	1.yes 2.no 3.no 4.no	1.yes 2.no 3.no 4.no	1.yes 2.yes 3.yes 4. yes	yes	no	no
33	Jahangir Gate	3-way	1.no 2.no 3.no	no	no	yes	no	yes
34	Mahakhali Rail Crossing	3-way	1.no 2.no 3.no	no	1.yes 2.yes 3.yes	yes	no	yes
35	Mahakhali Aam Toli	3-way	1.no 2.no 3.no	no	1.yes 2.yes 3.yes	yes	no	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
36	Chairman Bari	3-way	1.no 2.no 3.no	1.yes 2.no 3.no	no	yes	no	yes
37	Kakoli	4-way	1.yes 2.no 3.no 4.no	1.no 2. yes 3.no 4.no	1.no 2. yes 3.no 4.no	yes	no	yes
38	Gulshan-2	4-way	1.yes 2.yes 3.yes 4.yes	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
39	Muzib Avenue (Notun Bazar)	4-way	1.no 2.no 3.no 4.no	no	1.yes 2.yes 3.yes 4.no	yes	no	yes
40	Gulshan-1	4-way	1.no 2.no 3.no 4.no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
41	Malibagh Rail Crossing	3-way	1.no 2.no 3.no	no	1.yes 2.yes 3.yes	yes	no	yes
42	Mouchak	3-way	1.no 2.no 3.no	1.yes 2.no 3.no	1.yes 2.yes 3.yes (broken)	yes	no	no
43	Malibagh	3-way	1.no 2.no 3.no	no	1.yes 2.yes 3.yes	yes	no	yes
44	Rajarbagh	4-way	1.no 2.no 3.no 4.no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
45	Shahbagh	4-way	1.yes 2.yes 3.yes 4.yes	1.yes 2.no 3.yes 4.no	1.yes 2.yes 3.yes 4.yes	yes	yes	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
46	Ruposhi Bangla (Seraton)	3-way (Tee)	1.yes 2.yes 3.no	1.yes 2.no 3.no	1.yes 2.yes 3.no	yes	no	yes
47	Bangla Motor	4-way	1.no 2.no 3.no 4.no	1.yes 2.no 3.no 4.no	1.no 2.yes 3.yes 4.yes	yes	no	yes
48	Magh Bazar	4-way	1.no 2.no 3.no 4.no	1.yes 2.yes 3.yes 4.yes	1.no 2.no 3.no 4.no	yes	no	yes
49	Sonar-gaon	5-way	1.yes 2.yes 3.yes 4.yes 5.yes	1.no 2.no 3.no 4.no 4.yes	1.yes 2.yes 3.yes 4.yes 5.yes	yes	no	yes
50	Farmgate	7-way	No	3 Fob Cover Every Direction	1.yes 2.yes 3.yes	yes	no	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
51	Khamar bari	3-way	1.no 2.no 3.no	1.no 2.no 3.no	1.yes 2.yes 3.no	yes	no	yes
52	Matso Bhaban	4-way	1.yes 2.yes 3.no 4.no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
53	DPHE (Kakrail)	3-way	1.yes 2.no 3.no	1.yes 2.no 3.no	1.yes 2.yes 3.yes	yes	no	yes
54	AB bank (kakrail)	3-way	1.yes 2.yes 3.yes	no	1.yes 2.yes 3.yes	yes	no	yes
55	Rajmoni Cinema Hall (Kakrail)	4-way	1.yes 2.no 3.no 4.no	1.no 2.yes 3.no 4.no	1.yes 2.no 3.yes yes	yes	no	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
56	Fakira-pul	4-way	1.yes 2.yes 3.no 4.no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
57	Shapla Chattar	4-way (Round about)	1.no 2.no 3.no 4.no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
58	Ittefaq more	3-way	1.no 2.no 3.no	1.no 2.no 3.no	1.yes 2.yes 3.yes	yes	no	yes
59	Agargaon (IDB Bhaban)	4-way	1.no 2.no 3.no 4.no	no	1.yes 2.yes 3.yes 4.no	yes	no	yes
60	Nabisco (Tejgaon)	3-way (Tee)	1.no 2.no 3.no	no	1.yes 2.yes 3.no	yes	no	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
61	Tejgaon Link Road	4-way	1.no 2.no 3.no 4.no	no	1.yes 2.yes 3.yes 4.no	yes	no	yes
62	Shat Rasta (Tejgaon)	6-way	No	no	1.yes 2.no 3.no 4.no 5.no 6.no	yes	no	no
63	Gulistan square	4-way	1.no 2.no 3.no 4.no	1.yes 2.yes 3.yes 4.yes	1.yes 2.no 3.no 4.no	yes	no	yes
64	Kamla pur Rail station	4-way	1.no 2.no 3.no 4.no	1.no 2.no 3.no 4.no	1.yes 2.yes 3.yes 4.no	yes	no	yes
65	Kamla pur Container	3-way	1.no 2.no 3.no	1.no 2.no 3.no	1.yes 2.yes 3.yes	yes	no	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
66	Pirjongi Mazar	3-way	1.no 2.no 3.no	1.no 2.no 3.no	1.yes 2.yes 3.yes	yes	no	yes
67	Bijoy Nagar	3-way	1.yes 2.yes 3.no	no	1.yes 2.yes 3.yes	yes	no	yes
68	Habibullah Bahar college (Shanti Nagar)	3-way	1.no 2.no 3.no	1.no 2.no 3.no	1.yes 2.no 3.no	yes	no	yes
69	Shanti Nagar	4-way	1.no 2.no 3.no 4.no	no	1.yes 2.yes 3.yes 4.yes	yes	no	yes
70	Kadam Chatter	3-way	1.yes 2.no 3.no	1.no 2.no 3.no	1.yes 2.yes 3.yes	yes	no	yes

Table -A1 Existing Pedestrian facilities of Major Intersections in Dhaka city:

s.l no.	Name of Intersection	Intersection type	Visible Cross marking	Foot Over Bridge/ Under pass	Refuse Island	Traffic Police	Speed Breaker	Traffic signal
71	Dainik Banglar More	4-way	1.yes 2.yes 3.yes 4.yes	no	1.yes 2.yes 3.yes 4.yes	yes	no	no

Annex –A2: Recommended Signal for Exclusive Pedestrian Phase (EPP)



Fig A2.1: Signal for Exclusive Pedestrian Phase (EPP)

**Annex –A3: Traffic Volume
New Market Intersection**

	Intersection: Newmarket Direction: Sc Lab to DU			Morning (9.30-10.30)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	15	2.8	42
2	Private Car	609	1	609
3	Minibus	0	1.5	0
4	CNG Auto	168	0.4	67.2
5	Micro Bus	123	1.5	184.5
6	Tempo/ Leguna	36	1.5	54
7	Truck	0	2.8	0
8	Pick Up	9	1.5	13.5
9	Rickshaw	33	0.4	13.2
10	Push Cart	0	3	0
11	Motor Cycle	63	0.3	18.9
12	Bicycle	12	0.4	4.8
				1007.1
	Intersection: Newmarket Direction: Sc Lab to DU			Afternoon (5.00-6.00)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	3	2.8	8.4
2	Private Car	309	1	309
3	Minibus	0	1.5	0
4	CNG Auto	108	0.4	43.2
5	Micro Bus	51	1.5	76.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	72	0.4	28.8
10	Push Cart	0	3	0
11	Motor Cycle	69	0.3	20.7
12	Bicycle	33	0.4	13.2
				499.8

	Intersection: Newmarket	Morning
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	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	261	2.8	730.8
2	Private Car	159	1	159
3	Minibus	3	1.5	4.5
4	CNG Auto	15	0.4	6
5	Micro Bus	3	1.5	4.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	3	1.5	4.5
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	9	0.3	2.7
12	Bicycle	0	0.4	0
				912
	Intersection: Newmarket			Afternoon
	Direction: Sc Lab to Azimpur			(5.00-6.00)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	99	2.8	277.2
2	Private Car	120	1	120
3	Minibus	48	1.5	72
4	CNG Auto	3	0.4	1.2
5	Micro Bus	39	1.5	58.5
6	Tempo/ Leguna	3	1.5	4.5
7	Truck	0	2.8	0
8	Pick Up	12	1.5	18
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				551.4

Annex –A3: Traffic Volume

Annex –A3: Traffic Volume

Intersection: Newmarket Direction: Sc Lab to 1st gate of New Market			Morning (9.30-10.30)
Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
Bus	0	2.8	0
Private Car	27	1	27
Minibus	0	1.5	0
CNG Auto	15	0.4	6
Micro Bus	3	1.5	4.5
Tempo/ Leguna	24	1.5	36
Truck	0	2.8	0
Pick Up	3	1.5	4.5
Rickshaw	0	0.4	0
Push Cart	0	3	0
Motor Cycle	9	0.3	2.7
Bicycle	3	0.4	1.2
	0		0
			81.9
Intersection: Newmarket Direction: Sc Lab to 1st gate of New Market			Afternoon (5.00-6.00)
Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
Bus	0	2.8	0
Private Car	300	1	300
Minibus	3	1.5	4.5
CNG Auto	15	0.4	6
Micro Bus	33	1.5	49.5
Tempo/ Leguna	51	1.5	76.5
Truck	0	2.8	0
Pick Up	0	1.5	0
Rickshaw	0	0.4	0
Push Cart	0	3	0
Motor Cycle	12	0.3	3.6
Bicycle	0	0.4	0
	0		0
			440.1

Annex –A3: Traffic Volume

	Intersection: Newmarket Direction: DU to 1st Gate			Morning (9.30-10.30)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	12	2.8	33.6
2	Private Car	6	1	6
3	Minibus	0	1.5	0
4	CNG Auto	12	0.4	4.8
5	Micro Bus	6	1.5	9
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	120	0.4	48
10	Push Cart	0	3	0
11	Motor Cycle	6	0.3	1.8
12	Bicycle	12	0.4	4.8
13		0		0
				108
	Intersection: Newmarket Direction: DU to 1st Gate			Afternoon (5.00-6.00)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	72	1	72
3	Minibus	0	1.5	0
4	CNG Auto	0	0.4	0
5	Micro Bus	6	1.5	9
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	78	0.4	31.2
10	Push Cart	0	3	0
11	Motor Cycle	18	0.3	5.4
12	Bicycle	6	0.4	2.4
13		0		0
				120

Annex –A3: Traffic Volume

	Intersection: Newmarket Direction: DU to Azimpur		Morning (9.30-10.30)	
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	42	1	42
3	Minibus	0	1.5	0
4	CNG Auto	30	0.4	12
5	Micro Bus	0	1.5	0
6	Tempo/ Leguna	30	1.5	45
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				99
	Intersection: Newmarket Direction: DU to Azimpur		Afternoon (5.00-6.00)	
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	0	1	0
3	Minibus	0	1.5	0
4	CNG Auto	0	0.4	0
5	Micro Bus	0	1.5	0
6	Tempo/ Leguna	24	1.5	36
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	9	0.3	2.7
12	Bicycle	6	0.4	2.4
				41.1

Annex –A3: Traffic Volume

	Intersection: Newmarket			Morning (9.30-10.30)
	Direction: DU to Science Lab			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	648	1	648
3	Minibus	0	1.5	0
4	CNG Auto	156	0.4	62.4
5	Micro Bus	168	1.5	252
6	Tempo/ Leguna	120	1.5	180
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	42	0.3	12.6
12	Bicycle	18	0.4	7.2
				1162.2
	Intersection: Newmarket			Afternoon (5.00-6.00)
	Direction: DU to Science Lab			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	6	2.8	16.8
2	Private Car	222	1	222
3	Minibus	0	1.5	0
4	CNG Auto	66	0.4	26.4
5	Micro Bus	78	1.5	117
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	33	0.3	9.9
12	Bicycle	12	0.4	4.8
				396.9

Annex –A3: Traffic Volume

	Intersection: Newmarket Direction: Azimpur to DU			Morning (9.30-10.30)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	6	1	6
3	Minibus	0	1.5	0
4	CNG Auto	0	0.4	0
5	Micro Bus	30	1.5	45
6	Tempo/ Leguna	36	1.5	54
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				105
	Intersection: Newmarket Direction: Azimpur to DU			Afternoon (5.00-6.00)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	18	1	18
3	Minibus	0	1.5	0
4	CNG Auto	6	0.4	2.4
5	Micro Bus	0	1.5	0
6	Tempo/ Leguna	18	1.5	27
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
		0		47.4

Annex –A3: Traffic Volume

Intersection: Newmarket Direction: Azimpur to Sc. Lab			Morning (9.30-10.30)	
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	96	2.8	268.8
2	Private Car	72	1	72
3	Minibus	84	1.5	126
4	CNG Auto	18	0.4	7.2
5	Micro Bus	12	1.5	18
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
13		0		492
Intersection: Newmarket Direction: Azimpur to Sc. Lab			Afternoon (5.00-6.00)	
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	120	2.8	336
2	Private Car	114	1	114
3	Minibus	84	1.5	126
4	CNG Auto	48	0.4	19.2
5	Micro Bus	42	1.5	63
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	36	0.3	10.8
12	Bicycle	12	0.4	4.8
				673.8

Annex –A3: Traffic Volume

	Intersection: Newmarket			Morning (9.30-10.30)
	Direction: Azimpur to 1st gate of New Market			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	12	1	12
3	Minibus	0	1.5	0
4	CNG Auto	6	0.4	2.4
5	Micro Bus	0	1.5	0
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				14.4
	Intersection: Newmarket			Afternoon (5.00-6.00)
	Direction: Azimpur to 1st gate of New Market			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	6	1	6
3	Minibus	0	1.5	0
4	CNG Auto	0	0.4	0
5	Micro Bus	0	1.5	0
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	12	0.4	4.8
10	Push Cart	0	3	0
11	Motor Cycle	6	0.3	1.8
12	Bicycle	0	0.4	0
				12.6

Annex –A3: Traffic Volume

	Intersection: Newmarket			Morning
	Direction: 1st gate of New Market to DU			(9.30-10.30)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	66	1	66
3	Minibus	0	1.5	0
4	CNG Auto	18	0.4	7.2
5	Micro Bus	12	1.5	18
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	60	0.4	24
10	Push Cart	0	3	0
11	Motor Cycle	6	0.3	1.8
12	Bicycle	6	0.4	2.4
				128.4
	Intersection: Newmarket			Afternoon
	Direction: 1st gate of New Market to DU			(5.00-6.00)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	48	1	48
3	Minibus	0	1.5	0
4	CNG Auto	36	0.4	14.4
5	Micro Bus	30	1.5	45
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	24	0.4	9.6
10	Push Cart	0	3	0
11	Motor Cycle	12	0.3	3.6
12	Bicycle	6	0.4	2.4
				132

Annex –A3: Traffic Volume

	Intersection: Newmarket Direction: 1st gate of New Market to Azimpur			Morning (9.30-10.30)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	18	1	18
3	Minibus	0	1.5	0
4	CNG Auto	0	0.4	0
5	Micro Bus	6	1.5	9
6	Tempo/ Leguna	6	1.5	9
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
13		0		0
				36
	Intersection: Newmarket Direction: 1st gate of New Market to Azimpur			Afternoon (5.00-6.00)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	6	1	6
3	Minibus	0	1.5	0
4	CNG Auto	0	0.4	0
5	Micro Bus	6	1.5	9
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	6	0.4	2.4
10	Push Cart	0	3	0
11	Motor Cycle	30	0.3	9
12	Bicycle	0	0.4	0
13		0		0
				35.4

Annex –A3: Traffic Volume

	Intersection: Newmarket Direction: 1st gate of New Market to Sc Lab			Morning (9.30-10.30)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	6	1	6
3	Minibus	0	1.5	0
4	CNG Auto	12	0.4	4.8
5	Micro Bus	0	1.5	0
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	12	0.3	3.6
12	Bicycle	18	0.4	7.2
				21.6
	Intersection: Newmarket Direction: 1st gate of New Market to Sc Lab			Afternoon (5.00-6.00)
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	66	1	66
3	Minibus	0	1.5	0
4	CNG Auto	0	0.4	0
5	Micro Bus	0	1.5	0
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	6	0.4	2.4
10	Push Cart	0	3	0
11	Motor Cycle	24	0.3	7.2
12	Bicycle	0	0.4	0
				75.6

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: Bangla Motor to Farmgate			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	246	2.8	688.8
2	Private Car	663	1	663
3	Minibus	129	1.5	193.5
4	CNG Auto	348	0.4	139.2
5	Micro Bus	219	1.5	328.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	96	1.5	144
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	42	0.3	12.6
12	Bicycle	30	0.4	12
		0		2181.6
	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: Bangla Motor to Farmgate			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	429	2.8	1201.2
2	Private Car	657	1	657
3	Minibus	0	1.5	0
4	CNG Auto	594	0.4	237.6
5	Micro Bus	567	1.5	850.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	6	2.8	16.8
8	Pick Up	57	1.5	85.5
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	78	0.3	23.4
12	Bicycle	27	0.4	10.8
		0		3082.8

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: Bangla Motor to Pantho Path			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	12	2.8	33.6
2	Private Car	201	1	201
3	Minibus	0	1.5	0
4	CNG Auto	84	0.4	33.6
5	Micro Bus	30	1.5	45
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	39	0.3	11.7
12	Bicycle	12	0.4	4.8
		0		329.7
	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: Bangla Motor to Pantho Path			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	393	1	393
3	Minibus	0	1.5	0
4	CNG Auto	195	0.4	78
5	Micro Bus	102	1.5	153
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	144	0.3	43.2
12	Bicycle	0	0.4	0
				676.2

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: Bangla Motor to Tejgaon			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	6	2.8	16.8
2	Private Car	129	1	129
3	Minibus	0	1.5	0
4	CNG Auto	102	0.4	40.8
5	Micro Bus	36	1.5	54
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	12	0.3	3.6
12	Bicycle	0	0.4	0
				244.2

	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: Bangla Motor to Tejgaon			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	18	1	18
3	Minibus	0	1.5	0
4	CNG Auto	15	0.4	6
5	Micro Bus	33	1.5	49.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	9	0.3	2.7
12	Bicycle	9	0.4	3.6
		0		79.8

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: Tejgan to Bangla Motor and BIP Road			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	6	2.8	16.8
2	Private Car	576	1	576
3	Minibus	0	1.5	0
4	CNG Auto	180	0.4	72
5	Micro Bus	117	1.5	175.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	9	2.8	25.2
8	Pick Up	45	1.5	67.5
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	30	0.3	9
12	Bicycle	48	0.4	19.2
				961.2

	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: Tejgan to Bangla Motor and BIP Road			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	6	2.8	16.8
2	Private Car	225	1	225
3	Minibus	0	1.5	0
4	CNG Auto	93	0.4	37.2
5	Micro Bus	42	1.5	63
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	39	0.3	11.7
12	Bicycle	0	0.4	0
		0		353.7

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: Tejgan to Pantho Path			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	207	1	207
3	Minibus	0	1.5	0
4	CNG Auto	78	0.4	31.2
5	Micro Bus	81	1.5	121.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	18	0.3	5.4
12	Bicycle	6	0.4	2.4
				367.5

	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: Tejgan to Pantho Path			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	6	2.8	16.8
2	Private Car	99	1	99
3	Minibus	0	1.5	0
4	CNG Auto	48	0.4	19.2
5	Micro Bus	51	1.5	76.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	15	0.3	4.5
12	Bicycle	9	0.4	3.6
				219.6

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: Tejgan to Farmgate			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	75	1	75
3	Minibus	0	1.5	0
4	CNG Auto	84	0.4	33.6
5	Micro Bus	15	1.5	22.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	9	2.8	25.2
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				156.3

	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: Tejgan to Farmgate			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	27	1	27
3	Minibus	0	1.5	0
4	CNG Auto	6	0.4	2.4
5	Micro Bus	21	1.5	31.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	9	0.3	2.7
12	Bicycle	0	0.4	0
				63.6

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: Farmgate to Panto Path			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	33	1	33
3	Minibus	0	1.5	0
4	CNG Auto	0	0.4	0
5	Micro Bus	0	1.5	0
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				33
	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: Farmgate to Panto Path			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	42	1	42
3	Minibus	0	1.5	0
4	CNG Auto	69	0.4	27.6
5	Micro Bus	33	1.5	49.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	60	0.3	18
12	Bicycle	6	0.4	2.4
				139.5

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: Farmgate to Tejgaon			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	3	2.8	8.4
2	Private Car	84	1	84
3	Minibus	0	1.5	0
4	CNG Auto	33	0.4	13.2
5	Micro Bus	18	1.5	27
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	45	0.3	13.5
12	Bicycle	0	0.4	0
				146.1

	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: Farmgate to Tejgaon			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	117	1	117
3	Minibus	0	1.5	0
4	CNG Auto	84	0.4	33.6
5	Micro Bus	27	1.5	40.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	6	2.8	16.8
8	Pick Up	12	1.5	18
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	33	0.3	9.9
12	Bicycle	18	0.4	7.2
				243

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: Farmgate to Bangla Motor and BIP Road			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	489	2.8	1369.2
2	Private Car	1356	1	1356
3	Minibus	0	1.5	0
4	CNG Auto	429	0.4	171.6
5	Micro Bus	402	1.5	603
6	Tempo/ Leguna	0	1.5	0
7	Truck	18	2.8	50.4
8	Pick Up	96	1.5	144
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	129	0.3	38.7
12	Bicycle	81	0.4	32.4
				3765.3

	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: Farmgate to Bangla Motor and BIP Road			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	288	2.8	806.4
2	Private Car	435	1	435
3	Minibus	0	1.5	0
4	CNG Auto	339	0.4	135.6
5	Micro Bus	261	1.5	391.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	12	2.8	33.6
8	Pick Up	69	1.5	103.5
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	24	0.3	7.2
12	Bicycle	21	0.4	8.4
				1921.2

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: Pantho Path to Bangla Motor and Bip Road			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	12	2.8	33.6
2	Private Car	279	1	279
3	Minibus	0	1.5	0
4	CNG Auto	159	0.4	63.6
5	Micro Bus	138	1.5	207
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	18	1.5	27
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	33	0.3	9.9
12	Bicycle	39	0.4	15.6
		0		635.7

	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: Pantho Path to Bangla Motor and Bip Road			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	6	2.8	16.8
2	Private Car	195	1	195
3	Minibus	0	1.5	0
4	CNG Auto	177	0.4	70.8
5	Micro Bus	69	1.5	103.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	12	1.5	18
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	15	0.3	4.5
12	Bicycle	6	0.4	2.4
				411

Annex –A3: Traffic Volume

Intersection: Sonargaon				Morning(8am-9am)
Direction: Pantho Path to Tejgaon				
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	120	1	120
3	Minibus	0	1.5	0
4	CNG Auto	66	0.4	26.4
5	Micro Bus	21	1.5	31.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	21	0.4	8.4
				195.3

Intersection: Sonargaon				Afternoon(5pm-6pm)
Direction: Pantho Path to Tejgaon				
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	6	2.8	16.8
2	Private Car	111	1	111
3	Minibus	0	1.5	0
4	CNG Auto	42	0.4	16.8
5	Micro Bus	15	1.5	22.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	18	1.5	27
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	63	0.3	18.9
12	Bicycle	0	0.4	0
				213

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: Pantho Path to Farm Gate			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	9	2.8	25.2
2	Private Car	69	1	69
3	Minibus	0	1.5	0
4	CNG Auto	30	0.4	12
5	Micro Bus	18	1.5	27
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
13		0		0
				133.2

	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: Pantho Path to Farm Gate			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	90	1	90
3	Minibus	0	1.5	0
4	CNG Auto	36	0.4	14.4
5	Micro Bus	6	1.5	9
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				122.4

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: BIP Road to Pantho Path			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	12	2.8	33.6
2	Private Car	117	1	117
3	Minibus	0	1.5	0
4	CNG Auto	27	0.4	10.8
5	Micro Bus	33	1.5	49.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	6	2.8	16.8
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	39	0.3	11.7
12	Bicycle	0	0.4	0
				248.4

	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: BIP Road to Pantho Path			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	18	2.8	50.4
2	Private Car	183	1	183
3	Minibus	0	1.5	0
4	CNG Auto	120	0.4	48
5	Micro Bus	75	1.5	112.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	24	1.5	36
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	12	0.3	3.6
12	Bicycle	15	0.4	6
13		0		439.5

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: BIP Road to Tejgaon and Bangla Motor			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	135	1	135
3	Minibus	0	1.5	0
4	CNG Auto	123	0.4	49.2
5	Micro Bus	75	1.5	112.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	12	1.5	18
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	6	0.4	2.4
		0		317.1

	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: BIP Road to Tejgaon and Bangla Motor			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	102	1	102
3	Minibus	0	1.5	0
4	CNG Auto	30	0.4	12
5	Micro Bus	33	1.5	49.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
		0		172.5

Annex –A3: Traffic Volume

	Intersection: Sonargaon			Morning(8am-9am)
	Direction: BIP Road to Farm Gate			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	6	2.8	16.8
2	Private Car	123	1	123
3	Minibus	0	1.5	0
4	CNG Auto	18	0.4	7.2
5	Micro Bus	0	1.5	0
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	12	0.3	3.6
12	Bicycle	0	0.4	0
13		0		150.6

	Intersection: Sonargaon			Afternoon(5pm-6pm)
	Direction: BIP Road to Farm Gate			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	129	1	129
3	Minibus	0	1.5	0
4	CNG Auto	36	0.4	14.4
5	Micro Bus	6	1.5	9
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	9	0.3	2.7
12	Bicycle	0	0.4	0
				164.1

Annex –A3: Traffic Volume

	Intersection: Shahbagh		Morning(8am-9am)	
Direction: Ramna to Elephant Road				
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	54	2.8	151.2
2	Private Car	144	1	144
3	Minibus	24	1.5	36
4	CNG Auto	36	0.4	14.4
5	Micro Bus	30	1.5	45
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	36	0.3	10.8
12	Bicycle	0	0.4	0
				401.4

	Intersection: Shahbagh		Afternoon(5pm-6pm)	
	Direction: Ramna to Elephant Road			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	69	2.8	193.2
2	Private Car	306	1	306
3	Minibus	3	1.5	4.5
4	CNG Auto	135	0.4	54
5	Micro Bus	105	1.5	157.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	9	2.8	25.2
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	21	0.3	6.3
12	Bicycle	0	0.4	0
				746.7

Annex –A3: Traffic Volume

	Intersection: Shahbagh			Morning(8am-9am)
	Direction: Ramna to T.S.C			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	36	1	36
3	Minibus	0	1.5	0
4	CNG Auto	36	0.4	14.4
5	Micro Bus	0	1.5	0
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	18	0.3	5.4
12	Bicycle	0	0.4	0
				55.8

	Intersection: Shahbagh			Afternoon(5pm-6pm)
	Direction: Ramna to T.S.C			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	54	1	54
3	Minibus	0	1.5	0
4	CNG Auto	36	0.4	14.4
5	Micro Bus	21	1.5	31.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	33	0.3	9.9
12	Bicycle	0	0.4	0
				109.8

Annex –A3: Traffic Volume

	Intersection: Shahbagh			Morning(8am-9am)
	Direction: Ramna to Bangla Motor			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	246	2.8	688.8
2	Private Car	114	1	114
3	Minibus	120	1.5	180
4	CNG Auto	72	0.4	28.8
5	Micro Bus	12	1.5	18
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				1029.6

	Intersection: Shahbagh			Afternoon(5pm-6pm)
	Direction: Ramna to Bangla Motor			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	228	2.8	638.4
2	Private Car	246	1	246
3	Minibus	48	1.5	72
4	CNG Auto	36	0.4	14.4
5	Micro Bus	78	1.5	117
6	Tempo/ Leguna	0	1.5	0
7	Truck	12	2.8	33.6
8	Pick Up	12	1.5	18
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				1139.4

Annex –A3: Traffic Volume

Intersection: Shahbagh			Morning(8am-9am)	
Direction: Bangla Motor to Elepant Road				
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	303	1	303
3	Minibus	0	1.5	0
4	CNG Auto	192	0.4	76.8
5	Micro Bus	51	1.5	76.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	18	0.3	5.4
12	Bicycle	0	0.4	0
				470.7

	Intersection: Shahbagh		Afternoon(5pm-6pm)	
	Direction: Bangla Motor to Elepant Road			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	6	2.8	16.8
2	Private Car	372	1	372
3	Minibus	0	1.5	0
4	CNG Auto	111	0.4	44.4
5	Micro Bus	57	1.5	85.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	9	0.3	2.7
12	Bicycle	0	0.4	0
				530.4

Annex –A3: Traffic Volume

	Intersection: Shahbagh			Morning(8am-9am)
	Direction: Bangla Motor to Ramna			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	309	2.8	865.2
2	Private Car	48	1	48
3	Minibus	141	1.5	211.5
4	CNG Auto	54	0.4	21.6
5	Micro Bus	18	1.5	27
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	54	0.3	16.2
12	Bicycle	0	0.4	0
				1189.5

	Intersection: Shahbagh			Afternoon(5pm-6pm)
	Direction: Bangla Motor to Ramna			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	279	2.8	781.2
2	Private Car	105	1	105
3	Minibus	24	1.5	36
4	CNG Auto	66	0.4	26.4
5	Micro Bus	24	1.5	36
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	15	0.3	4.5
12	Bicycle	9	0.4	3.6
13	Horse Cart	2	3	6
				1007.7

Annex –A3: Traffic Volume

	Intersection: Shahbagh			Morning(8am-9am)
	Direction: Bangla Motor to T.S.C			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	249	1	249
3	Minibus	0	1.5	0
4	CNG Auto	189	0.4	75.6
5	Micro Bus	72	1.5	108
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				432.6

	Intersection: Shahbagh			Afternoon(5pm-6pm)
	Direction: Bangla Motor to T.S.C			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	246	1	246
3	Minibus	0	1.5	0
4	CNG Auto	249	0.4	99.6
5	Micro Bus	39	1.5	58.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	15	1.5	22.5
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	15	0.3	4.5
12	Bicycle	0	0.4	0
				431.1

Annex –A3: Traffic Volume

	Intersection: Shahbagh			Morning(8am-9am)
	Direction: Elephant Road to T.S.C			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	63	1	63
3	Minibus	0	1.5	0
4	CNG Auto	0	0.4	0
5	Micro Bus	9	1.5	13.5
6	Tempo/ Leguna	6	1.5	9
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	9	0.4	3.6
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
13		0		0
				89.1

	Intersection: Shahbagh			Afternoon(5pm-6pm)
	Direction: Elephant Road to T.S.C			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	78	1	78
3	Minibus	0	1.5	0
4	CNG Auto	6	0.4	2.4
5	Micro Bus	15	1.5	22.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	9	0.3	2.7
12	Bicycle	0	0.4	0
				105.6

Annex –A3: Traffic Volume

	Intersection: Shahbagh			Morning(8am-9am)
	Direction: Elephant Road to Ramna			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	213	2.8	596.4
2	Private Car	495	1	495
3	Minibus	12	1.5	18
4	CNG Auto	114	0.4	45.6
5	Micro Bus	117	1.5	175.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	9	2.8	25.2
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	45	0.3	13.5
12	Bicycle	6	0.4	2.4
				1380.6

	Intersection: Shahbagh			Afternoon(5pm-6pm)
	Direction: Elephant Road to Ramna			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	84	2.8	235.2
2	Private Car	375	1	375
3	Minibus	9	1.5	13.5
4	CNG Auto	249	0.4	99.6
5	Micro Bus	219	1.5	328.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	66	1.5	99
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	72	0.3	21.6
12	Bicycle	0	0.4	0
				1172.4

Annex –A3: Traffic Volume

	Intersection: Shahbagh		Morning(8am-9am)	
	Direction: Elephant Road to Bangla Motor			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	471	1	471
3	Minibus	0	1.5	0
4	CNG Auto	21	0.4	8.4
5	Micro Bus	54	1.5	81
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	27	0.3	8.1
12	Bicycle	0	0.4	0
		0		577.5

	Intersection: Shahbagh			Afternoon(5pm-6pm)
	Direction: Elephant Road to Bangla Motor			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	6	2.8	16.8
2	Private Car	279	1	279
3	Minibus	0	1.5	0
4	CNG Auto	150	0.4	60
5	Micro Bus	48	1.5	72
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	6	1.5	9
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	39	0.3	11.7
12	Bicycle	0	0.4	0
				448.5

Annex –A3: Traffic Volume

Intersection: Shahbagh				Morning(8am-9am)
Direction: T.S.C to Ramna				
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	42	1	42
3	Minibus	6	1.5	9
4	CNG Auto	15	0.4	6
5	Micro Bus	0	1.5	0
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				57

Intersection: Shahbagh				Afternoon(5pm-6pm)
Direction: T.S.C to Ramna				
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	36	1	36
3	Minibus	0	1.5	0
4	CNG Auto	15	0.4	6
5	Micro Bus	12	1.5	18
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				60

Annex –A3: Traffic Volume

	Intersection: Shahbagh			Morning(8am-9am)
	Direction: T.S.C to Bangla Motor			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	6	2.8	16.8
2	Private Car	333	1	333
3	Minibus	0	1.5	0
4	CNG Auto	312	0.4	124.8
5	Micro Bus	135	1.5	202.5
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	30	1.5	45
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	18	0.3	5.4
12	Bicycle	0	0.4	0
				727.5

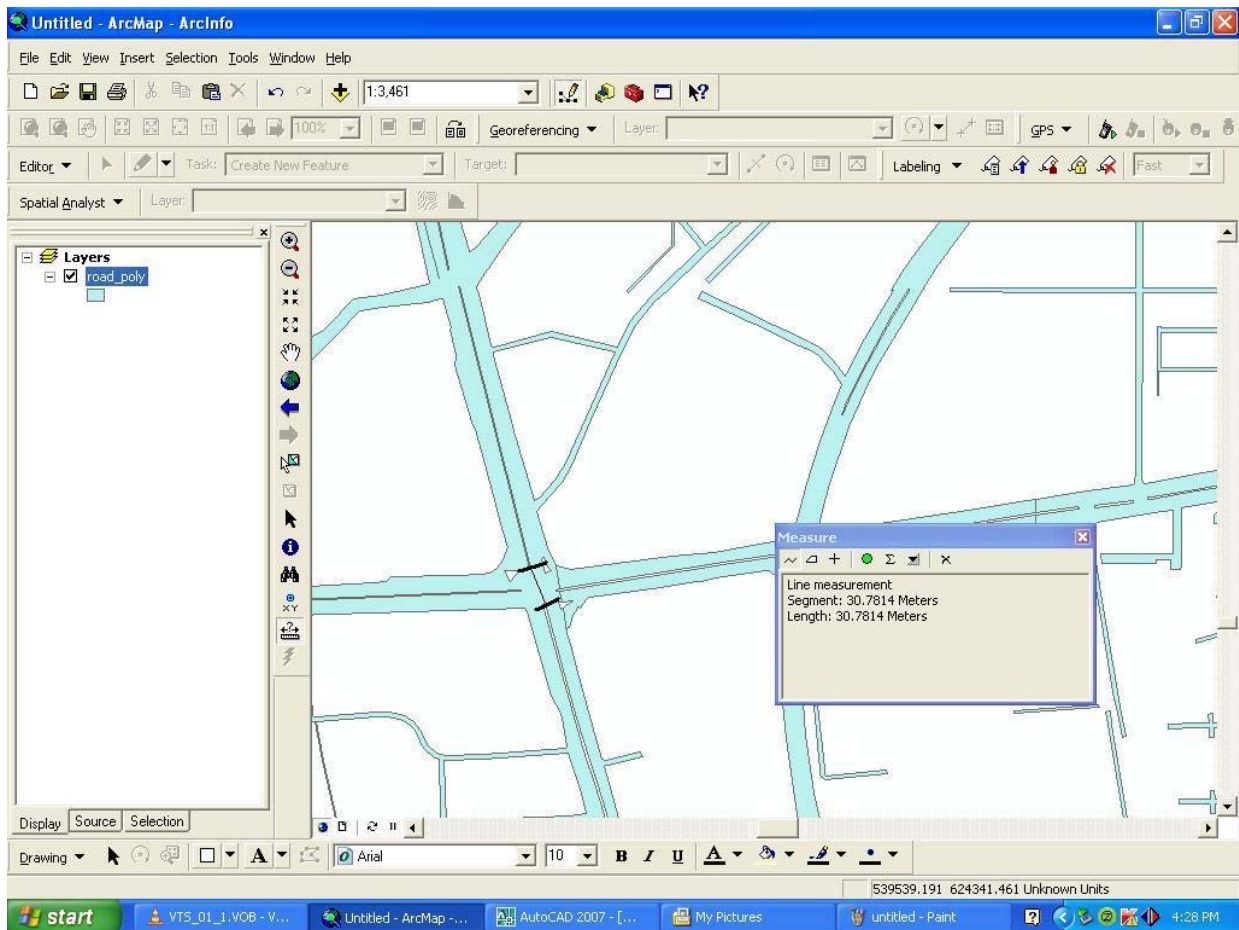
	Intersection: Shahbagh			Afternoon(5pm-6pm)
	Direction: T.S.C to Bangla Motor			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	39	2.8	109.2
2	Private Car	555	1	555
3	Minibus	0	1.5	0
4	CNG Auto	576	0.4	230.4
5	Micro Bus	450	1.5	675
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	39	1.5	58.5
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	84	0.3	25.2
12	Bicycle	42	0.4	16.8
				1670.1

Annex –A3: Traffic Volume

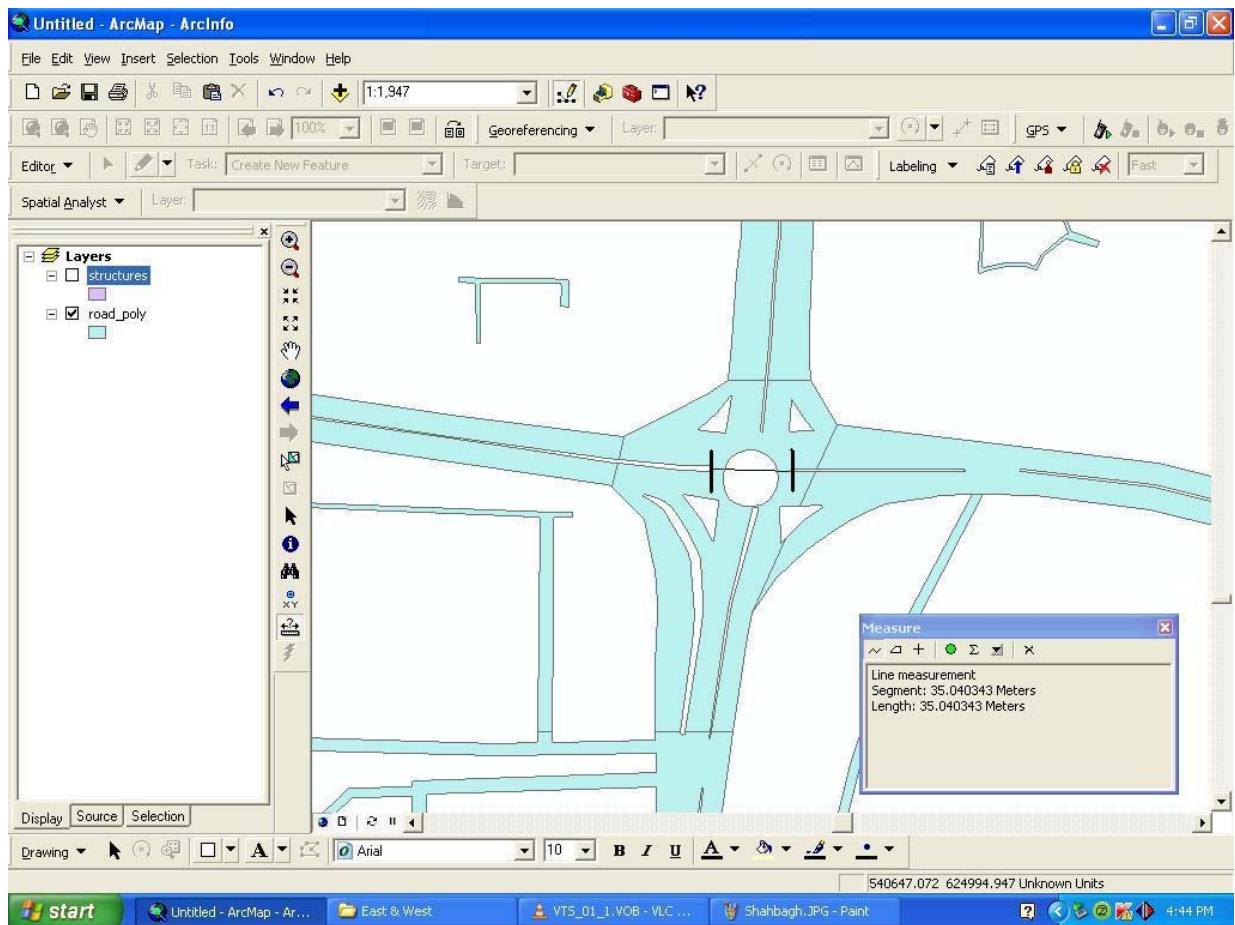
	Intersection: Shahbagh		Morning(8am-9am)	
	Direction: T.S.C to Elephant Road			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	78	1	78
3	Minibus	0	1.5	0
4	CNG Auto	18	0.4	7.2
5	Micro Bus	24	1.5	36
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	18	0.3	5.4
12	Bicycle	0	0.4	0
				126.6

	Intersection: Shahbagh		Afternoon(5pm-6pm)	
	Direction: T.S.C to Elephant Road			
	Vehicle type	Total vehicle (1 hour)	PCU value	Total PCU
1	Bus	0	2.8	0
2	Private Car	195	1	195
3	Minibus	0	1.5	0
4	CNG Auto	30	0.4	12
5	Micro Bus	72	1.5	108
6	Tempo/ Leguna	0	1.5	0
7	Truck	0	2.8	0
8	Pick Up	0	1.5	0
9	Rickshaw	0	0.4	0
10	Push Cart	0	3	0
11	Motor Cycle	0	0.3	0
12	Bicycle	0	0.4	0
				315

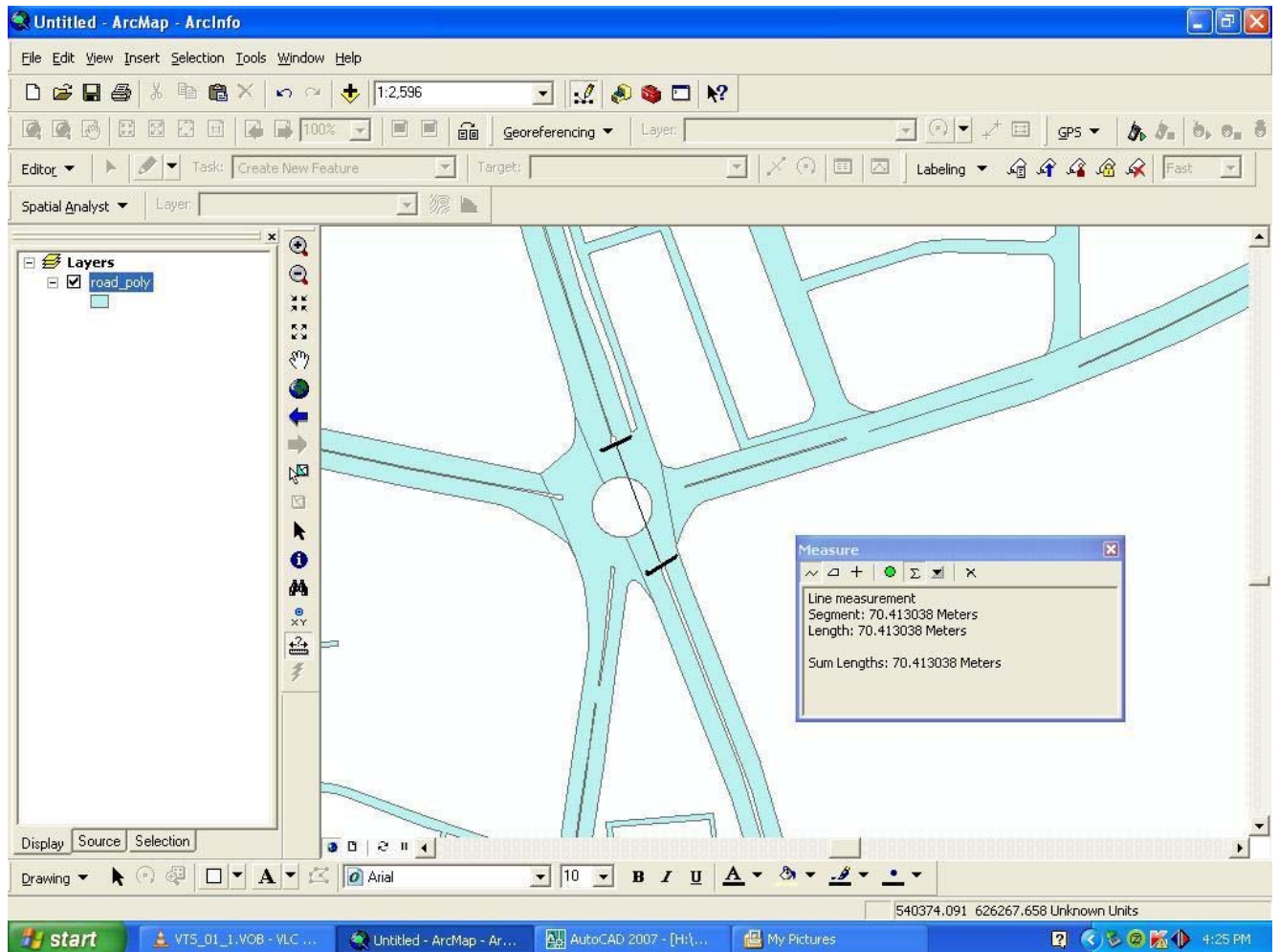
Annex-A4:
Newmarket Intersection : from GIS data of DAP , RAJUK



Annex-A4:
Shahbagh Intersection: from GIS data of DAP , RAJUK



Annex-A4:
Sonargaon Intersection from GIS data of DAP , RAJUK



Annex-A5:

Table: 1 Newmarket Intersection(Delay)Cycle length with exclusive pedestrian phase, C
27+31=158

Direction	Cycle length (sec)	green	Ef. Green (gi)	Critical. fl(vi)	Saturation Flow Rate(vph)	x	y	Delay (sec/ cycle)
DU to Sc. Lab	158	45	45.6	1162	3575	0.5061	0.6750	59.23
DU to 1 no. gate of nemarket	158	45	45.6	108	3575	0.5061	0.9698	41.23
DU to Azimpur	158	45	45.6	99	3575	0.5061	0.9723	41.12
Sc.Lab to Du	158	39	39.6	1007	3575	0.5616	0.7183	61.76
Sc.Lab to Azim pur	158	39	39.6	912	3575	0.5616	0.7449	59.56
Sc.Lab to Sc.Lab+1no gate	158	39	39.6	819	3575	0.5616	0.7709	57.55
1no gate to azimpur	158	5	5.6	36	3575	0.9304	0.9899	74.25
1no gate to DU.	158	5	5.6	128	3575	0.9304	0.9642	76.23
1no gate to Sc.Lab	158	5	5.6	21	3575	0.9304	0.9941	73.93
Azimpur to Sc Lab	158	26	26.6	674	3575	0.6916	0.8115	67.33
Azimpur to DU	158	26	26.6	105	3575	0.6916	0.9706	56.29
Azimpur to 1 no. Gate	158	26	26.6	15	3575	0.6916	0.9958	54.87

Annex-A5:

Table:2 Newmarket Intersection (Delay)Cycle length without exclusive pedestrian phase, C =152

Direction	Cycle Length (sec)	green	Ef. Green (gi)	Critical. fl(vi)	Saturation Flow Rate(vph)	x	y	Delay (sec/ cycle)
DU to Sc. Lab	152	56	56.6	1162	3575	0.3939	0.6750	44.35
DU to 1 no. gate of nemarket	152	56	56.6	108	3575	0.3939	0.9698	30.87
DU to Azimpur	152	56	56.6	99	3575	0.3939	0.9723	30.79
Sc.Lab to Du	152	40	40.6	1007	3575	0.5371	0.7183	56.83
Sc.Lab to Azim pur	152	40	40.6	912	3575	0.5371	0.7449	54.80
Sc.Lab to Sc.Lab+1no gate	152	40	40.6	819	3575	0.5371	0.7709	52.95
1no gate to azimpur	152	7	7.6	36	3575	0.9025	0.9899	69.29
1no gate to DU.	152	7	7.6	128	3575	0.9025	0.9642	71.14
1no gate to Sc.Lab	152	7	7.6	21	3575	0.9025	0.9941	69.00
Azimpur to Sc Lab	152	37	37.6	674	3575	0.5665	0.8115	53.05
Azimpur to DU	152	37	37.6	105	3575	0.5665	0.9706	44.35
Azimpur to 1 no. Gate	152	37	37.6	15	3575	0.5665	0.9958	43.23

Annex-A5:

Table: 3 Shahbag Intersection (Delay) Cycle length with exclusive pedestrian phase, C = 247+58= 305

Direction	Cycle length (sec)	green	Ef.Green (gi)	Critical.fl (vi)	Saturation Flow Rate(vph)	x	y	Delay (sec/cycle)
TSC to Bangla Motor	305	73	73.6	1670	5890	0.5756	0.7165	122.52
TSC to Ramna	305	73	73.6	60	5890	0.5756	0.9898	88.68
TSC to Elephant road	305	73	73.6	315	5890	0.5756	0.9465	92.74
Ramna to Bangla Motor	305	50	50.6	1139	5890	0.6957	0.8066	131.53
Ramna to elephant road	305	50	50.6	747	5890	0.6957	0.8732	121.51
Ramna to TSC	305	50	50.6	110	5890	0.6957	0.9813	108.12
Bangla Motor to TSC	305	52	52.6	432	5890	0.6848	0.9267	112.70
Bangla Motor to Ramna	305	52	52.6	1189	5890	0.6848	0.7981	130.85
Bangla Motor to elephant road	305	52	52.6	530	5890	0.6848	0.9100	114.76
Elephant road to Bangla Motor	305	60	60.6	577	5890	0.6421	0.9020	108.55
Elephant road to Ramna	305	60	60.6	1380	5890	0.6421	0.7657	127.88
Elephant road to TSC	305	60	60.6	105	5890	0.6421	0.9822	99.70

Annex-A5:

Table: 4 Shahbag Intersection (Delay) Cycle length without exclusive pedestrian phase, C =300

Direction	Cycle length (sec)	green	Ef.Green (gi)	Critical.fl (vi)	Saturation Flow Rate(vph)	x	y	Delay (sec/cycle)
TSC to Bangla Motor	300	61	61.6	1670	5890	0.6315	0.7165	132.21
TSC to Ramna	300	61	61.6	60	5890	0.6315	0.9898	95.70
TSC to Elephant road	300	61	61.6	315	5890	0.6315	0.9465	100.08
Ramna to Bangla Motor	300	85	85.6	1139	5890	0.5107	0.8066	94.98
Ramna to elephant road	300	85	85.6	747	5890	0.5107	0.8732	87.74
Ramna to TSC	300	85	85.6	110	5890	0.5107	0.9813	78.07
Bangla Motor to TSC	300	65	65.6	432	5890	0.6105	0.9267	98.82
Bangla Motor to Ramna	300	65	65.6	1189	5890	0.6105	0.7981	114.73
Bangla Motor to elephant road	300	65	65.6	530	5890	0.6105	0.9100	100.63
Elephant road to Bangla Motor	300	78	78.6	577	5890	0.5446	0.9020	90.57
Elephant road to Ramna	300	78	78.6	1380	5890	0.5446	0.7657	106.69
Elephant road to TSC	300	78	78.6	105	5890	0.5446	0.9822	83.18