Traffic Volume and Peak Flow Study of Russel Square to Panthapath Corridor

By

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Declaration

I declare that this study was composed by myself, that the work contained herein is my own works & efforts, except where explicitly stated otherwise in the text, and that this work has not been submitted anywhere for any awards. The entirety of contents included here is totally based on my own labour along with my groupmates assigned for the completion of the Traffic Volume Study. Necessary references have been included for further study, along with all the sources of information.

Acknowledgement

All praise is due to the Almighty, the most merciful and most beneficent.

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I also acknowledge the heartiest co-operation of my groupmates of group 4 for the entirety of their labour and efforts for the completion of this study.

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Abstract

Traffic engineering uses engineering methods and techniques to achieve the safe and time efficient movement of people and goods on roadways. The safe and time efficient movement of the people and goods is dependent on Traffic flow, which is directly connected to the traffic characteristics. The three main parameters of a traffic flow are volume, speed, and density. The purpose of this study is to find the traffic volume characteristics of a specific location. The location was chosen on the road near Panthapath intersection, the direction was specified for group 4 as Russel square to Panthapath intersection. The objective of this study is multifaceted, in the sense of having specific objectives and general objectives which lead to the scope of various design, improvement related findings. A preliminary survey was conducted to choose the type of vehicles & their approximate ratio. Then the vehicle count was found by manual methods and manual equipment were used. The result found in this survey was documented and percentages were found for other study procedures. The data collected from all the groups were used to find composition, direction of flow, PHF (Peak Hour Factor). With the help of the data collection, an attempt had been made to understand the traffic patterns during different time periods. Traffic control at that junction is also dependent on the traffic flow characteristics. Hence the results from the present study are helpful in controlling the traffic at the intersection and in suggesting some of the remedial measures to improve the overall flow with the employment of variable road median, controlled personalized vehicles can lead to a better flow composition, rate and overall lower congestion for the corridor.

Table of Contents

Chapter One

Introduction

Transportation being one of the most crucial and significant parts of a country's economy and development, undoubtedly it demands lots of studies and researches in this sector. For this reason, traffic studies are conducted. These traffic studies do help in deciding the geometric design features, traffic control for efficient traffic movement. Traffic studies are carried out in several parts so that people can comprehend the results best possible unambiguously. So, in this process of traffic studies, the foremost that need to know is- which units and how many units of transportation comprise the traffic for a specific road, that is, traffic volume. The term 'Traffic volume study' can be termed as traffic flow survey or simply the traffic survey. It is defined as the procedure to determine mainly volume of traffic moving on the roads at a particular section during a particular time. When several types of vehicles function on a road, then traffic volume study doesn't conclude in simply counting those vehicles per unit time. The heterogeneity of vehicles must be eliminated by converting them into one standard vehicle unit. So, by addressing diverseness of vehicles in terms of capacity, different types of vehicles can be converted into equivalent passenger cars and then their volume is expressed in terms of Passenger Car Unit (PCU) per hour.

Our study purposes can be divided into Design, Improvement, and Planning purposes, as delineated below:

<u>Design Purposes:</u>

A) Structural Designs: various structural and geometric designs of pavements, bridge, and other highway facilities. Structural design is based on repetition of wheel load on the pavement in entire design life. AADT is needed with traffic growth rate to

compute design wheel repetition. Geometric design is based on peak hour volume to avoid congestion.

B) Intersection design: includes but not limited to minimum turning path, channelization, flaring, traffic control devices viz. traffic signs, markings, signals based on approach volume and turning proportions.

C) Sidewalk Considerations: Pedestrian volume study is useful for designing sidewalks, pedestrian crossing etc.

Improvement Purposes:

A) Prioritization of Projects: To allocate limited maintenance budget rationally, it is important to know the traffic volume carried by a particular roadway section in order to decide the importance of the road and fixing its relative priority

B) Roadway Condition: To improve roadway operating condition, to examine existing operating/service condition, to check necessity of traffic control devices it is of utmost importance to know the traffic volume

Planning Purposes:

A) Road Maintenance Schedules: Accurate information on the amount of traffic on the roads is vital for the planning of both road maintenance and improvement policies

B) Expansion & Construction: Traffic volume network analysis helps in deciding/planning if there is need for improvements or expansion in terms of constructing missing links, by-pass, alternative roads etc.

In terms of specific objectives of our study, the following showcase the overall outcomes in terms of information:

A) Magnitudes, classifications and the time and directional split of vehicular flows: Magnitude is represented by volume of traffic. Vehicles are classified into some

predefined classes based on vehicle size and capacity. In a two-way road, vehicles moving towards two directions are counted separately to get the proportion. Time and directional split are useful to identify tidal flow.

B) Proportion of Vehicles: Represented as a pie chart, the proportion of various class of vehicles will be analysed. Furthermore, directional distribution will also be showcased, highlighting the proportion of traffic in each direction.

C) Flow Fluctuation: Flow fluctuation on different approaches at a junction or different parts of a road network system, which is represented as Passenger Car Units (PCU)

Chapter Two

Literature Review

2.1 Introduction

To understand the characteristics and service levels, a proper study on the traffic flow pattern and its variability over time is of utmost importance. However, the main problem in developing such is the heterogeneity of the traffic stream, in the consideration of Dhaka Metropolitan Area. As various types of vehicles produce various impedance, simply adding the number of vehicles does not give a proper representation, rather, passenger car is adopted as a standard vehicle and other vehicles' numbers are converted with respect to its passenger car equivalent. This factor to convert is known as Passenger Car Unit (PCU) and is adopted to give an accurate estimate of the number of vehicles on each direction. Furthermore, for design purposes various parameters of traffic such as vehicular composition, flow rate, directional distribution, and Average Annual Daily Traffic (AADT) must be addressed as well to consider the impact of heterogeneity on the overall flow of traffic, geometry of the road, condition, and congestion.

Various researchers and countries have adopted various PCU factors and Expansion Factors to convert representative samples of traffic volume of short count to PCE and year-round average traffic volumes, but in the context of Bangladesh such studies have been seldom done. Previous studies carried out by Roads and Highway Department, as a part of Developments of Geometric Design Standards (1994) and STP (Strategic Transport Plan for Dhaka, 2005) provided the various factors used in the study.

The following chapter will delineate the various terminology, methods and previous works done on such studies while emphasizing on the methods adopted.

2.2 Previous Studies

Globally, the importance of identifying vehicular flow characteristics have been understood since the 1930s, going so far as to counting year-wide continuous count. Shelton (1938) examined the grouping of traffic volume by hour, day, and month at two sites in Iowa. For the two sites, hourly manual traffic volume observation was conducted for 1 year. The analysis of variability at these sites specified that "there are no additional hours of wider variation not included." Shelton sought to identify the optimal number of manual count hours at a site.

Petroff (1956) calculated the coefficient of variation (the standard deviation divided by the mean and multiplied by 100) for New Mexico short-term-count ADT and true ADT. The calculations were for primary rural road systems and were based on a sample of 172 counts of 7 days' duration. The coefficient of variation was calculated as 8.0 percent. The New Mexico data comprised one of the largest samples in Petroff's study and had one of the lowest coefficients of variation. This calculation was used to support the conclusion that the ADT estimate would be accurate with a coefficient of variation of no more than ± 10 percent.

Ritchie (1986) further expanded upon Shelton's work to provide insights on the useability of short count to reflect upon annual traffic. He began with the following equation to estimate AADT from a short-term traffic count:

$$AADT = VOL\ (F_s)(F_A)(F_G)$$

Where

AADT = annual average daily traffic,

F_S = seasonal adjustment factor for the count month,

F_A = weekday axle correction factor, and

F_G = annual growth factor if no count was taken in the current year.

Zheng and Mc Donald (2012) found that manual counts derived from video recordings had counting errors which were small, usually less than 1%, while the classification errors were significant, with an average between 4-5%. The main errors are classification errors, reflection of difficulties in judging vehicles by a length criterion of 5.2 m from video recordings. Findlay (2011) and Pal'o et al (2019) found that automatic counters can lead to high variability on shorter counts, leading to as high as 40% differences for 15 minute intervals. Thus, for accurate and economic counting method, manual counting method can be easily employed and used to have higher accuracy on year-wide traffic flow which leads to the determination of various factors to estimate the traffic flow in Bangladesh.

Roads and Highway Department's study (1994) led to the identification of traffic characteristics of some important highways of Bangladesh. The work was expanded on by Rahman (2002) to identify the vehicular flow pattern on Jamuna Multipurpose Bridge using automated counts from toll plaza. STP (2005) identified various PCU factors necessary for a heterogeneous traffic scenario, and was employed by Zaman (2006) to shed light on the traffic flow characteristics of various rural roads in Bangladesh which highlighted the propriety of short count methods in the context of Bangladesh. Abdullah et al. (2021) also highlights the necessity of such methods to identify traffic composition of Dhaka City.

2.3 Definition of Related Terms

Before going into the detail of this study, it is important to get familiarized with the terms related to traffic flow characteristics and computation of expansion factors or equations. Therefore, in this section, the important parameters of traffic flow, which are frequently used in this study, are stated in brief.

Traffic Volume: Traffic Volume is defined as the number of vehicles that pass a particular point along a roadway or traffic lane per unit of time. Volume is a measure to quantify the traffic flow and is commonly measured in units of vehicles per hour, vehicles per day and so on.

ADT: ADT stands for Annual Daily Traffic and is defined by the average number of vehicles that pass a particular point during a period greater than one day and less than one year. It is determined by dividing the total number of vehicles within a period by the number of days.

ADT is a fundamental measurement of traffic that is used for the determination of the vehicle-kilometre of travel on the various categories of highway system. Vehicle kilometres are important for the development of highway financing or taxation schedules, the evaluation of safety programs, and as a measure of service provided by a highway transportation system.

AADT: Average Annual Daily Traffic is represented by the total number of vehicles passing a particular point, averaged over one year data. AADT is a very important factor for geometric design of highways.

Peak Hour Factor: The Peak Hour Factor (PHF) is defined as the ratio of total hourly volume to the maximum rate of flow within the hour.

$$PHF = \frac{Hourly\ Volume}{Peak\ rate\ of\ flow\ within\ the\ hour}$$

If 15-minute periods are used, the PHF is computed as:

$$PHF = \frac{Peak\ Hour\ Volume}{4 \times Volume\ during\ the\ peak\ 15\ minute\ of\ flow}$$

Directional Distribution: Directional distribution refers to the percentage of traffic flow in one direction during a particular time of day. This factor is particularly important in the case of commuter roads, where maximum flow occurs in one direction in the morning and the other in the evening. This also needs to be considered for efficient geometric design.

2.4 Types of Volume Counts

Different types of traffic counts are carried out, depending on the anticipated use of the data to be collected. They are:

Cordon Counts: When information is required on vehicle accumulation within an area such as the central business district (CBD) of a city, particularly during a specific time, a cordon count is undertaken. The area for which the data are required is cordoned off by an imaginary closed loop; the area enclosed within this loop is defined as the cordon area. Figure 1.1 shows such an area where the CBD of a city is enclosed by the imaginary loop ABCDA. The intersection of each street crossing the cordon line is taken as a count station; volume counts of vehicles and/or persons entering and leaving the cordon area are taken. The information obtained from such a count is useful for planning parking facilities, updating and evaluating traffic operational techniques, and making long-range plans for freeway and arterial street systems

Intersection Counts: Intersection counts are taken to determine vehicle classifications, through movements, and turning movements at intersections. These data are used mainly in determining phase lengths and cycle times for signalized intersections, in the design of channelization at intersections, and in the general design of improvements to intersections

Pedestrian Volume Counts: Volume counts of pedestrians are made at locations such as subway stations, midblock, and crosswalks. The counts are usually taken at these locations when the evaluation of existing or proposed pedestrian facilities is to be undertaken. Such facilities may include pedestrian overpasses or underpasses. Pedestrian counts can be made using the TDC-12 electronic manual counter described earlier and shown in Figure **XX**. The locations at which pedestrian counts are taken also include intersections, along sidewalks, and

Figure 1: TDC-12 electronic manual counter

mid-block crossings. These counts can be used for crash analysis, capacity analysis, and determining minimum signal timings at signalized intersections

Periodic Volume Counts: To obtain certain traffic volume data, such as AADT, it is necessary to obtain data continuously. However, it is not feasible to collect continuous data on all roads because of the cost involved. To make reasonable estimates of annual traffic volume characteristics on an area wide basis, different types of periodic counts, with count durations ranging from 15 minutes to continuous, are conducted; the data from these different periodic counts are used to determine values that are then employed in the estimation of annual traffic characteristics. The periodic counts usually conducted are:

A) Continuous (Long Count)

B) Control (Short Count)

C) Coverage Counts

Continuous Counts: These counts are taken continuously using mechanical or electronic

Figure 2: Continuous Counting Device

counters showed in Figure **XX**. Stations at which continuous counts are taken as permanent count stations. In selecting permanent count stations, the highways within the study area must first be properly classified. Each class should consist of highway links with similar traffic patterns and characteristics. A highway link is defined for traffic count purposes as a homogeneous section that has the same traffic characteristics, such as AADT and daily, weekly, and seasonal variations in traffic volumes at each point. Broad classification systems for major roads may include freeways, expressways, and major arterials. For minor roads, classifications may include residential, commercial, and industrial streets.

Control Counts: These counts are taken at stations known as control-count stations, which are strategically located so that representative samples of traffic volume can be taken on each

type of highway or street in an area-wide traffic counting program. The data obtained from control counts are used to determine seasonal and monthly variations of traffic characteristics so that expansion factors can be determined. These expansion factors are used to determine year-round average values from short counts.

2.5 Expansion Factors

To make reasonable estimates of annual traffic volume characteristics on an area-wide basis, different types of periodic counts with count durations ranging from 15 minutes to continuous, are conducted. Periodic volume counts are used to calculate expansion factors needed to estimate the annual traffic volume.

Hourly Expansion Factors: (HEFs) are determined by the following formula

$$HEF = \frac{Total\ Volume\ for\ 24-hr\ period}{Volume\ for\ particular\ hour}$$

These factors are used to expand counts of durations shorter than 24 hour to 24-hour volumes by multiplying the hourly volume for each hour during the count period by the HEF for that hour and finding the mean of these products.

Daily Expansion Factors: (DEFs) are computed as

$$DEF = \frac{Average\ total\ volume\ for\ week}{Average\ volume\ for\ particular\ day}$$

These factors are used to determine weekly volumes from counts of 24-hour duration by multiplying the 24-hour volume by the DEF.

Monthly Expansion Factors: (MEFs) are computed as

$$MEF = \frac{AADT}{ADT\ for\ Particular\ Month}$$

The AADT for a given year may be obtained from the ADT for a given month by multiplying this volume by the MEF.

Table 5 Hourly Expansion Factors

Hour	Volume	HEF	Hour	Volume	HEF
6:00-7:00 a.m.	294	42.01	6:00-7:00 p.m.	743	16.62
7:00-8:00 a.m.	426	28.99	7:00-8:00 p.m.	706	17.49
8:00-9:00 a.m.	560	22.05	8:00-9:00 p.m.	606	20.38
9:00-10:00 a.m.	657	18.8	9:00-10:00 p.m.	489	25.26
10:00-11:00 a.m.	722	17.11	10:00-11:00 p.m.	396	31.19
11:00-12:00 p.m.	667	18.52	11:00-12:00 a.m.	360	34.31
12:00-1:00 p.m.	660	18.71	12:00-1:00 a.m.	241	51.24
1:00-2:00 p.m.	739	16.71	1:00-2:00 a.m.	150	82.33
2:00-3:00 p.m.	832	14.84	2:00-3:00 a.m.	100	123.5
3:00-4:00 p.m.	836	14.77	3:00-4:00 a.m.	90	137.22
4:00-5:00 p.m.	961	12.85	4:00-5:00 a.m.	86	143.6
5:00-6:00 p.m.	892	13.85	5:00-6:00 a.m.	137	90.15

Table 6 Daily Expansion Factors

Day of Week	Volume	DEF
Sunday	7895	9.515
Monday	10714	7.012
Tuesday	9722	7.727
Wednesday	11413	6.582
Thusrday	10714	7.012
Friday	13125	5.724
Saturday	11539	6.51

Table 7 Monthly Expansion Factors

Day of Week	ADT	MEF
January	1350	1.756
February	1200	1.976
March	1450	1.635
April	1600	1.482
May	1700	1.395
June	2500	0.948
July	4100	0.578
August	4550	0.521
September	3750	0.632
October	2500	0.948
November	2000	1.186
December	1750	1.355

Figure 3: Expansion Factors used in the Study

2.6 Methods for Counting

There are two major methods of counting vehicle for volume survey. They are

A. Manual Counting Method and

B. Automatic counting method.

Manual Counting Method: In this method, vehicles are counted manually. There are two methods of manual counting:

A) Direct Method and
B) Indirect Method.

Direct Method: Data is counted by using hand tally a nd manual counters/enumerators.

Advantages: By this method traffic volume as well as vehicle classification and turning proportions can be obtained. Data can be used immediately after collection.

Disadvantages: This method is not practicable for long duration count and when flow is high.

Figure 6: Direct Method Counting adopted in this study

Figure 5: Mechanical Hand Tally Machine

Error is common especially when volume is high. Count cannot be cross checked. Count cannot be done in bad weather.

Indirect Method: In this method, data is collected using video camera. Video is captured for long time and data is collected later by rewinding.

Advantages: Besides traffic volume, several traffic parameters can be obtained from recorded film. Data can be cross checked, and quality can be ensured. This method is applicable when volume is high. It is suitable for non-lane-based traffic operation.

Disadvantages: A suitable elevated place is required for filming operation. Data cannot be used immediately after collection. Data must be manually transcribed from recorded film. This process is time consuming and tedious. Because of limitation of capacity of film, it is not suitable for long duration counts. Quality of video recorded on film is dependent on intensity of light and this method is not suitable in overcast days.

Automatic counting method: In this method, vehicles are counted automatically without any human involvement. There are two techniques of automatic counting:

A) Contact system based on pneumatic, mechanical, magnetic, or piezo-electric method and

B) Contactless system based on electrical/optical, ultrasound/infrared radar, micro wave, CCTV/video image processing method etc.

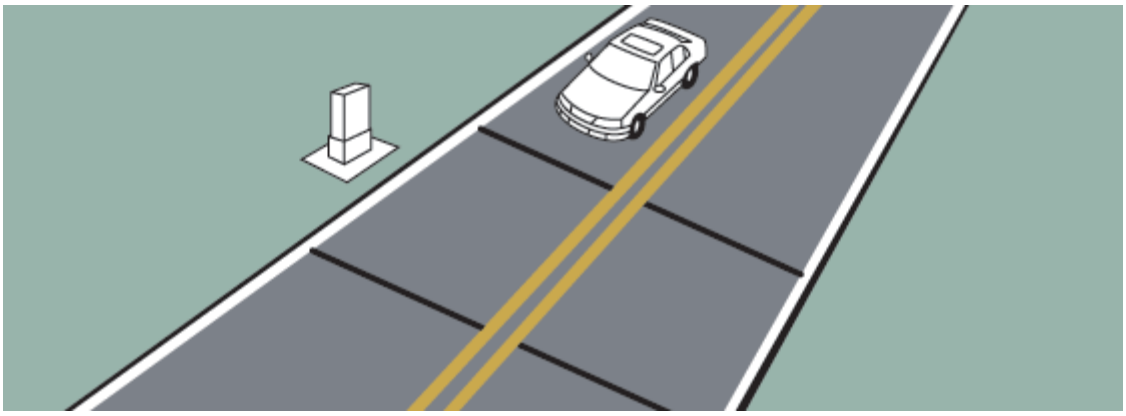

Figure 7: Contactless Automatic Optical Counter

Advantages: This method is suitable for long duration or continuous count. It is used as permanent counting station. It does not need manpower and is free from human error. Data is obtained in usable format. It is less expensive as manpower is not needed. Count is not affected by bad weather condition.

Disadvantages: It requires strict lane discipline. Non-motorized vehicles are hard to detect by this method. Detailed classification of vehicle is not possible. Accuracy is less than manual method. Installation cost is high.

Counting periods: Vehicles can be counted for any duration. Duration of count depends on the objective of data collection. For traffic control and management or operational studies short duration count at peak period is conducted. For planning and design purpose, long duration count is conducted.

Chapter Three

Methodology

3.1 Survey Brief

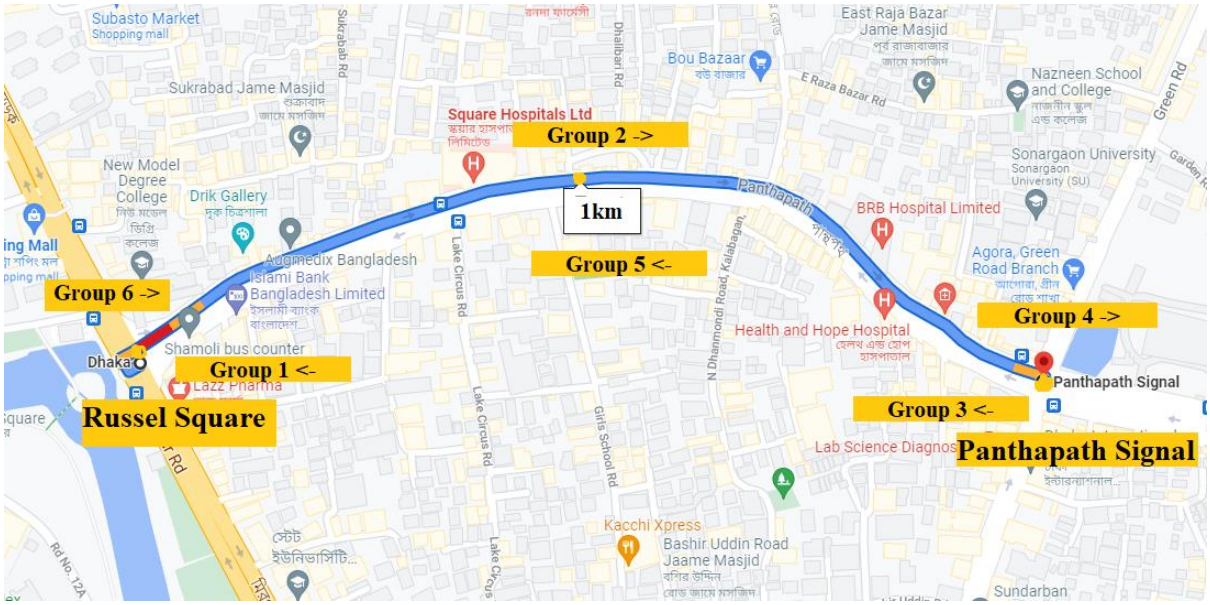

Figure 8: Survey Area and Group Distribution

Location: Overall 6 groups were distributed, with 3 on each side of the road from Russel Square to Panthapath Mor and in reverse. The group distribution is showcased in the figure **XX**

Date: Data was collected from 9.15 AM to 9.45 AM on December 23rd, 2021.

Weather Condition: It was mostly sunny with slight chilly breeze at times.

Method: Direct Manual Method

Duration: 30 Minutes (Short Count)

Equipment: Stopwatch, Mechanical Hand Tally Counter, Clip Board

Number of Enumerators: 6 in each group

3.2 Survey procedure

Reconnaissance: Before our survey, we got a rough idea of the location from Google Street View. We used it to look for good positions from where we could conduct our study and noted several ones. When we finally arrived on the site, we conducted a reconnaissance of the area. We went around and looked for suitable positions, including the ones we had preselected in Google Street View. After some scouting, we finally selected a particular position for our survey. It had a clear view of the road, and it was possible to clearly see

vehicles on the road. The point we selected was located around 15 to 22 feet away from the intersection. We did not select the intersection as it was easier for us to count vehicles on the road where the flow was unidirectional, and it was easier to select a reference object against which we could count the passing of vehicles.

Figure 9: Traffic Flow near intersection, which led to the shift in counting point

Survey Design/Piloting: Before conducting the study we formulated a plan for the task. We allocated vehicle types to group members and in addition we also selected a reference object against which to count vehicles. As cars and motorcycles are fast and small, and in our case rather plentiful, we allocated it to those who were good at counting.

Trial Survey: We tested out our plan by conducting a trial survey and made some observations. Light vehicles were rather numerous while buses and trucks were few. Also, the mechanical counters were not always reliable.

Adjustment to Survey Design: To adjust, we allocated more people to count light vehicles, subdividing the category into smaller ones and giving each category to one person. Buses and truck being few were only counted by one person.

Final Survey**:** For our main survey, we counted vehicles using the rear bumper method, i.e., we only counted a vehicle when its rear bumper had passed the reference object. We also made sure that the mechanical counter was accurately recording every input.

Data Analysis: All groups were able to collect data from the same time interval, 9.15 AM to 9.45 AM. As such, the flow fluctuation could not be recorded. Thus, for the data analysis part, we assumed the following time intervals for the groups:

Time	Groups
8.00 – 8.30 AM	3, 6
9.00 – 9.30 AM	5,2
10.00 – 10.30 AM	1,4

We used this assumption for all our analyses except the PHF calculation. This is, because the peak flow obtained was not the actual peak (as all readings were recorded at the same time). Thus, for PHF calculation, we used data of our group, which is group 4.

Chapter Four

Data Analysis

4.1 Vehicle Composition

Table: Total vehicle composition of traffic stream in Panthapath Signal to Russel Square direction with percentage

	Motorized Vehicles (Direction: Panthapath Signal to Russel Square)							
Time	**Group**	**Bus (B)**	**Truck (T)**	**Light Vehicle (LV)**	**Auto Rickshaw (AR)**	**Small Public Transport (SP)**	**Motorcycle (M)**	**Total Vehicles**
8:00 - 8:30 AM	3	7	3	283	146	0	191	630
9:00 - 9:30 AM	5	7	0	347	158	0	150	662
10:00 - 10:30 AM	1	7	3	229	105	0	136	480
	Total	**21**	**6**	**859**	**409**	**0**	**477**	**1772**
	Percentage %	**1.19**	**0.34**	**48.48**	**23.08**	**0.00**	**26.92**	**100.00**

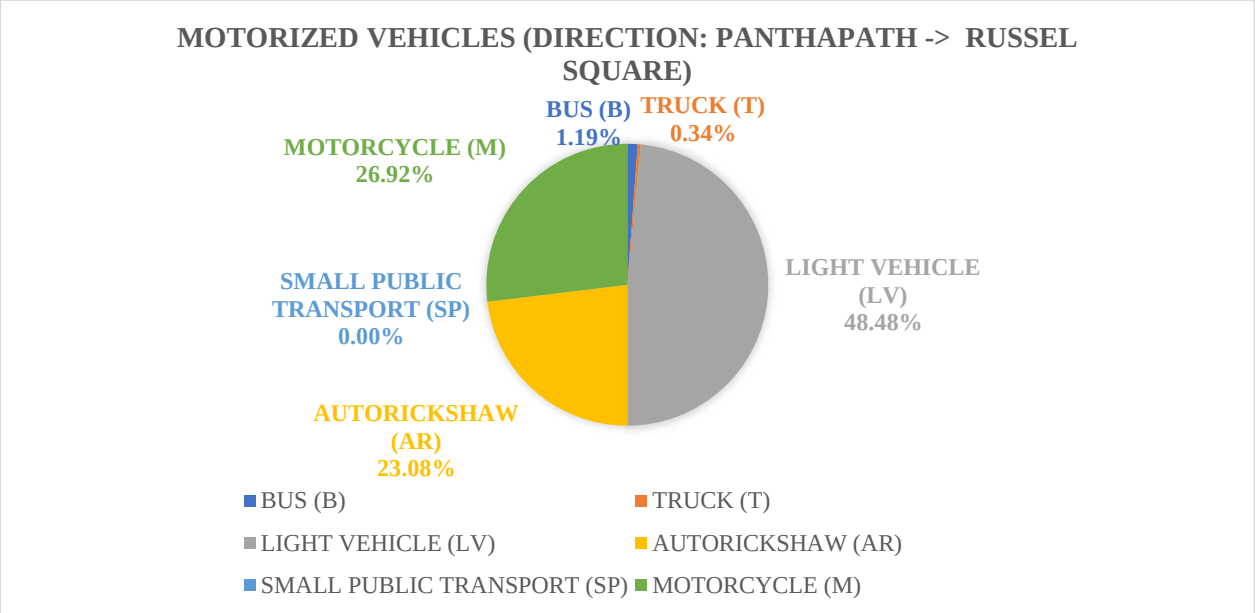

Figure 10: Motorized Vehicle Composition from Panthapath Signal to Russel Square

Table: Total vehicle composition of traffic stream in Russel square to Panthapath direction with percentage

	Motorized Vehicles (Direction: Russel Square to Panthapath Signal)							
Time	**Group**	**Bus (B)**	**Truck (T)**	**Light Vehicle (LV)**	**Auto Rickshaw (AR)**	**Small Public Transport (SP)**	**Motorcycle (M)**	**Total Vehicles**
8:00 - 8:30 AM	6	22	4	414	150	0	350	940
9:00 - 9:30 AM	2	8	3	532	168	0	379	1090
10:00 - 10:30 AM	4	11	0	520	205	0	349	1085
	Total	41	7	1466	523	0	1078	3115
	Percentage %	1.32	0.22	47.06	16.79	0.00	34.61	100.00

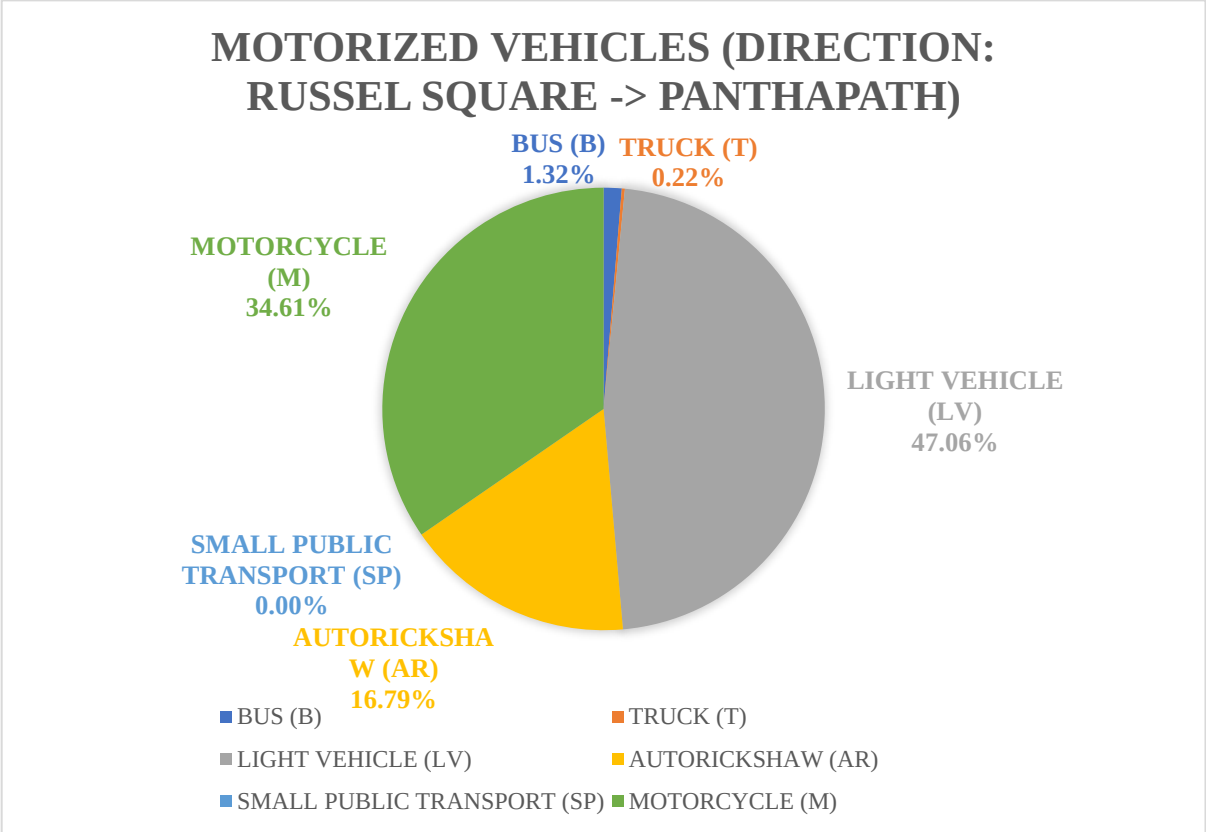

Figure 11: Motorized Vehicle Composition from Panthapath Signal to Russel Square

4.2 Service Flow Rate

Panthapath Signal to Russel Square Direction:

Table: Conversion table of vehicles into PCU and flow rate calculation

		GROUP		
	PCE	**3(8:00 AM)**	**5(9:00 AM)**	**1(10:00 AM)**
BUS (B)	2.68	7	7	7
TRUCK (T)	2.68	3	0	3
LIGHT VEHICLE (LV)	1	283	347	229
AUTORICKSHAW (AR)	0.52	146	158	105
SMALL PUBLIC TRANSPORT (SP)	0.51	0	0	0
MOTORCYCLE (M)	0.29	191	150	136
TOTAL PCU		**441.11**	**491.42**	**349.84**
PCU/HR		**882.22**	**982.84**	**699.68**

Sample flow rate for group 4 (PCU/hr) = $\frac{757.29 \times 60}{30}$

= 1514.58

Russel Square to Panthapath Signal Direction:

Table: Conversion table of vehicles into PCU and flow rate calculation for other direction

		GROUP		
	PCE	**6(8:00 AM)**	**2(9:00 AM)**	**4(10:00 AM)**
BUS (B)	2.68	22	8	11
TRUCK (T)	2.68	4	3	0
LIGHT VEHICLE (LV)	1	414	532	520
AUTORICKSHAW (AR)	0.52	150	168	205
SMALL PUBLIC TRANSPORT (SP)	0.51	0	0	0
MOTORCYCLE (M)	0.29	350	379	349
TOTAL PCU		663.18	758.75	757.29
PCU/HR		**1326.36**	**1517.50**	**1514.58**

4.3 Directional Distribution

Service flow rate in Panthapath - Russel square direction: 982.84 PCU/hr

Service flow rate in Russel square – Panthapath direction: 1517.50 PCU/hr

Table: Directional Distribution

Direction	PCU/hr	Total	Directional Distribution
Panthapath to Russel Square	982.84	2500.34	39.31
Russel Square to Panthapath	1517.50		60.69

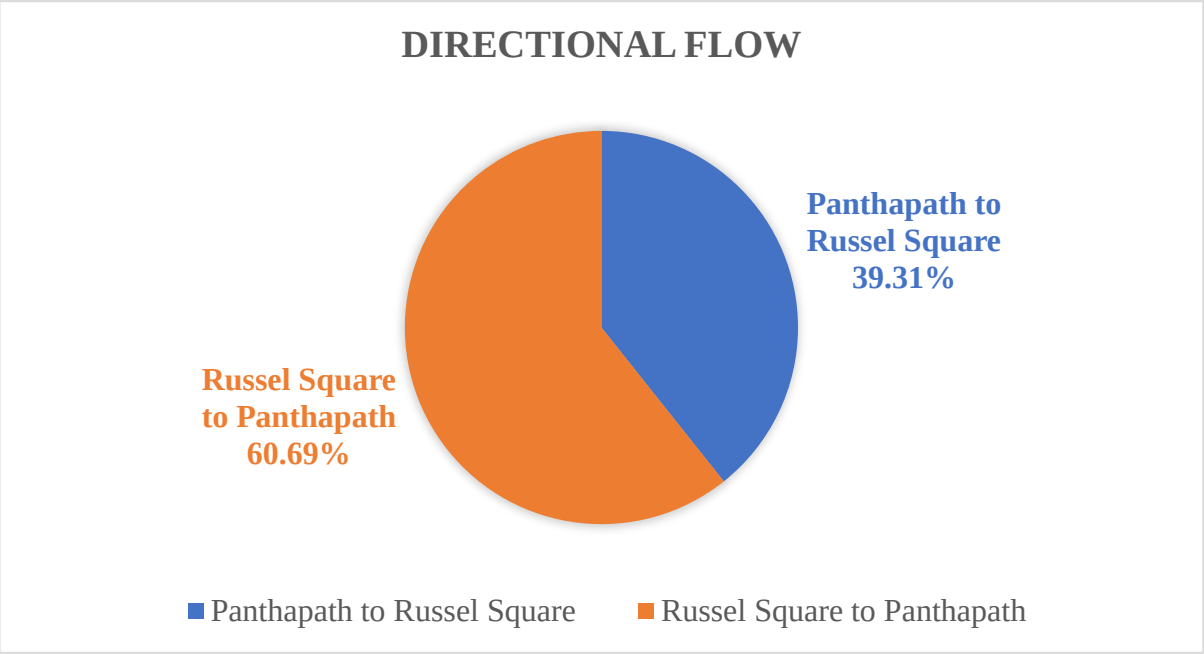

Figure 12: Directional Distribution

4.4 Peak Hour Factor (PHF)

The peak hour volume is just the sum of the volumes of the 4 15-minute intervals within the peak hour (1514.58 PCU). The peak 15-minute volume is 401.22 PCU in this case. The peak hour factor (PHF) is found by dividing the peak hour volume by four times the peak 15-minute volume.

$$PHF = \frac{Hourly\ Volume}{Peak\ rate\ of\ flow\ within\ the\ hour}$$

PHF = 1514.58/ (4 * 401.22) = **0.94373**

The actual (design) flow rate can be calculated by dividing the peak hour volume by the PHF, 1514.58/0.94373 = 1604.89 PCU/hr, or by multiplying the peak 15-minute volume by 4 4 * 401.22 = **1604.89 pcu/hr.**

4.5 Average Daily Traffic (ADT) & Annual Average Daily Traffic (AADT)

Here, MEF = 1.355 for December, DEF = 7.012 for Thursday,

HEF=18.8 (Time: 9-10 AM) (Group 2,3,5,6)

= 17.11 (Time: 10-11 AM) (Group 1 & 4)

Estimated 24-hour volume for Thursday (Panthapath to Russel Square), using HEF

$$= \frac{882.22\times22.05+ 982.84\text{x } 18.80 + 699.68 \text{ x } 17.11}{3}$$

$$= 16633.96 \text{ PCU}$$

From 24-hour volume for Thursday estimated volume for the week using DEF, Total 7 days volume

= 16633.96 x 7.012

= 116637.3 PCU

= 116637 PCU

Average 24 hours volume (on average daily traffic, ADT)

= 116637 /7

=16662.47 PCU

=16662 PCU (Panthapath to Russel Square) (Group-1, 3,5)

Since the data were collected in December, using the MEF for December obtained AADT is

AADT=18827× 1. 355

=22578

Now, ADT in Panthapath to Russel square direction: 16662 PCU

AADT in Panthapath to Russel square direction: 22578 PCU

Estimated 24-hour volume for Thursday (Russel Square to Panthapath), using HEF

$$= \frac{1326.36\times22.05+ 1517.5\text{x } 18.80 + 1514.58 \text{ x } 17.11}{3}$$

= 27896.57 PCU

= 27897 PCU

From 24 hour volume for Thursday estimated volume for the week using DEF, Total 7 days volume

= 27897 x 7.012

= 195610.73 PCU

= 195611 PCU

Average 24 hours volume (on average daily traffic, ADT)

= 195611/7

=27944.39 PCU

=27944 PCU (Russel Square to Panthapath) (Group-2,4,6)

Since the data were collected in December, using the MEF for December obtained AADT is

AADT=27944× 1.355

=37865

Now, **ADT in Russel Square to Panthapath direction: 27944 PCU**

AADT in Russel Square to Panthapath direction: 37865 PCU

4.6 Flow Fluctuation Curve

Table: ADT Percentage in each direction with time

Time	Panthapath to Russel Square Flow Rate (PCU/hr)	Russel Square to Panthapath Flow Rate (PCU/hr)	Panthapath to Russel Square, ADT	Russel Square to Panthapath, ADT	Panthapath to Russel Square, (%ADT)	Russel Square to Panthapath, (%ADT)
8:00 - 9:00 AM	882.22	1326.36	16662.47	27944.39	5.2946528	7.960164
9:00 - 10:00 AM	982.84	1517.5			5.8985248	9.107293
10:00 - 11:00 AM	699.68	1514.58			4.199137	9.089768

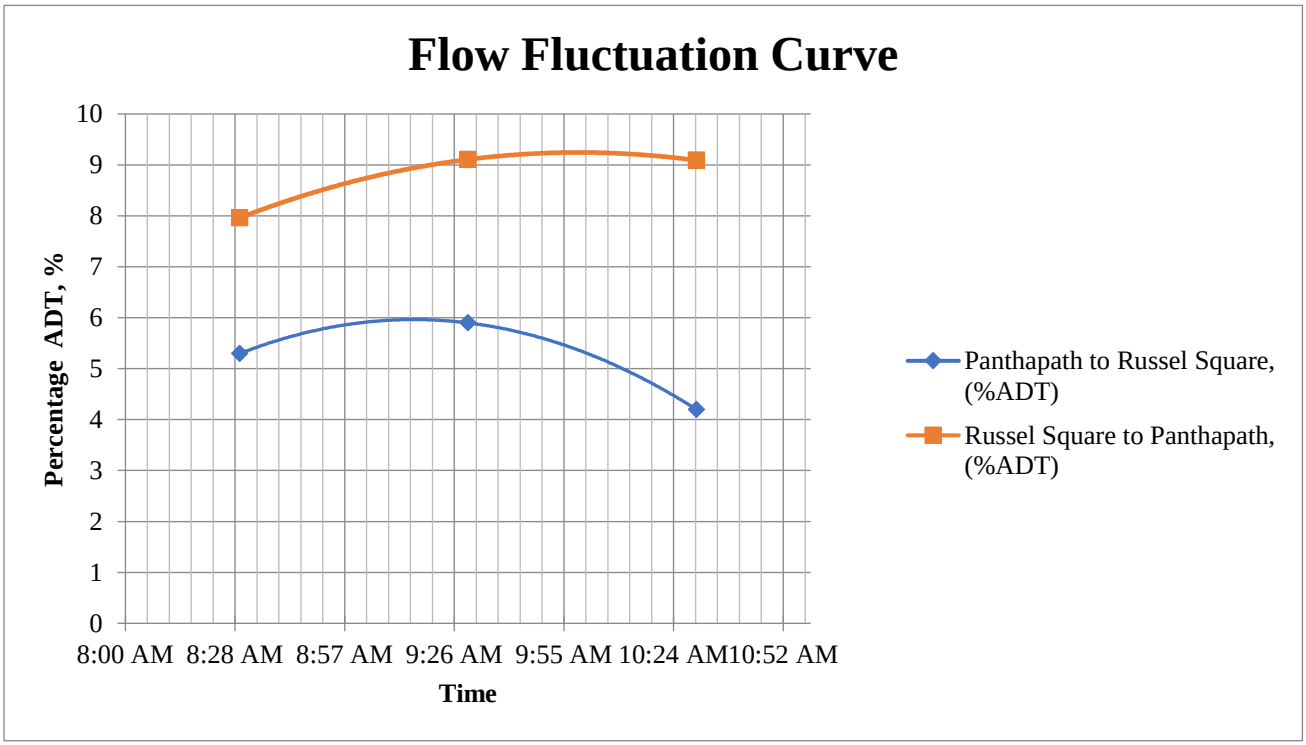

Figure 13: Flow Fluctuation Curve

Chapter 5

Conclusion & Recommendations

As traffic congestion becomes an ever-growing problem, the necessity of understanding the traffic flow is multifaceted. The following conclusions were drawn from our survey along with the limitations that led to the erroneous data:

5.1 Discussion on Vehicle Composition

Light vehicles take up nearly half the portion (48%) of vehicle flow in each direction, while Motorcycles and Autorickshaws take up nearly equal standings at 27% and 23% correspondingly. As the road acts as a connector/Service Road to two major roads of Dhaka Metropolitan Area, the road is mostly used by private transport instead of public ones, as can be seen from almost 1% composition of Buses. Furthermore, as the road is congested with hospitals on either side, there was a high proportion of ambulances as well. Rickshaws and non-motorized vehicles were not legal allowed on the road; however, they were moving in swarms which lead to the flow being disturbed now and then. If proper steps were taken and various buses were available on the road for connecting purposes, such flow of motorcycles, autorickshaws and rickshaws would not be seen. Optimum vehicle composition should have 40% public transport, which must be ensured.

5.2 Discussion on Directional Distribution

60.69% of the vehicles were moving from Russel Square towards Panthapath Signal, while 39.31% of vehicles were in the opposite direction. This is primarily due to office workers going to their respective workplaces on the road (e.g., shopping complexes, hospitals, private

firms' offices) on the former side of the road, leading them to take that direction in the morning rush hour period

5.3 Discussion on Flow Fluctuation

Each group counted vehicles for 30 minutes. Flow rate was calculated from that short count data, then converted to 1hr value and plotted. The flow fluctuation curve shows one peak at 9.30 – 10.00 am. From the flow fluctuation curve, it is seen that the vehicle movement in the direction of Russel square to Panthapath varies less comparatively. Percentage Of ADT is higher for Panthapath to Russell Square direction at 9.30-10.00 AM. However, a proper flow fluctuation curve is supposed to have two peaks in the day, with one peak being in morning and the other being near the evening. But as the flow was measured in morning time only, the curve has only one peak.

5.4 Recommendations

A) Vehicle Composition of the road needs to be altered by strict enforcement of laws, leading to higher percentage of public transports and buses
B) Non-Motorized Vehicles should be strictly restricted and must be enforced by local authorities
C) As the road acts as a connector for two major roads of Dhaka Metropolitan Area, alleyways and access roads should be locked up to stop from adding disturbances to the flow
D) As directional distribution is hugely varied in each direction at different times, Flow separation devices could be used to alleviate congestion

5.5 Limitations

A) Resource constraint was a big limitation, leading to manual short count methods, however it also provided some advantages as discussed before.

B) The study was conducted over 30 minutes only for the whole day's flow, which led to erroneous data, whereas for proper data the survey should be conducted for a period of one hour

C) Each group consisted of 6 members only, however, for accurate counting in such heterogeneous case at least 20 persons are required. Resource constraint is the prime cause for each of the limitations stated above.

5.6 Recommendations for Future Work

A) More funding should be acquired for accurate representation of the study

B) Availability of modern equipment needs to be ensured, e.g., Video Processing

C) The study sheds light on the necessity of further work on speed flow studies in urban road links for future works

References

Abdullah, M. S., Nowreen, S., Zaman, R. U., Hasnat, S., Satu, S. M., & Chowdhury, M. E. (2021). Urbanising Delta: What Lessons Dhaka Offers to Face Challenges. *Journal of Policy & Governance*, 1-21.

Findlay, D. J. (2011). Comparison of mobile and manual data collection for roadway components. *Transportation Research Part C, 19*(3), 521-540.

Louis Berger Group and Bangladesh Consultant Ltd. (2005). *Strategic Transport Plan for Dhaka.*

Pal'o, J., Caban, J., & Černický, L. (2019). The comparison of automatic traffic counting and manual traffic counting. *IOP Conf. Series: Materials Science and Engineering*, (p. 710).

Petroff, B. B. (1956). Experience in Application of Statistical Method to Traffic Counting. *Public Roads*.

Rahman, S. (2002). *Study of Vehicular Flow Pattern on Jamuna Multipurpose Bridge Access Road.* Dhaka: Military Institute of Science & Technology (MIST).

Ritchie, S. (1986). A Statistical Approach to Statewide Traffic Counting. *Transportation Research Record 1090*, 14.

Roads and Highways Department, GOB. (1994). *Road Material and Standards Study Bangladesh* (Vol. VIIA).

Shelton, W. A. (1938). Dispersion of Highway Traffic by Time Periods: Medium and Small Stations in Farm Area. *HRB Proc.*

Zaman, H. U. (2006). *Traffic Flow Characteristics and Modeling for Estimation of AADT in Selected Rural Highways.* Dhaka: Department of Civil Engineering, BUET.

Zheng, P., & Mc Donald, M. (2012). An Investigation on the Manual Traffic Count Accuracy. *Pro-Social and Behavioral Sciences*.