SPOT SPEED ANALYSIS OF VEHICULAR TRAFFIC AND TRAVEL TIME IN BIRULIA TO DHOUR CORRIDOR

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CERTIFICATION

This is to certify that this project and thesis entitled "**Spot Speed Analysis of Vehicular Traffic and Travel Time in Birulia To Dhour Corridor**" is done by the following students under my direct supervision and this work has been carried out by them in the Department of Civil Engineering under the Faculty of Engineering of Daffodil International University in partial fulfillment of the requirements for the degree of Bachelor of Science in Civil Engineering. The presentation of the work was held on 10 May 2023.

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ABSTRACT

Dhaka, Bangladesh's capital city is the epicenter of all governmental, economic and social activities, but traffic congestion and delays are prevalent issues. The primary goal of this study is to comprehend the current state of spot speed and journey time of vehicular traffic along a corridor that spans from Birulia to Dhour which is almost one kilometer in length. To analyze spot speed, we manually collected travel time data using a smartphone's stopwatch in 3 locations (Birulia, NDE gate, Panchabati) along corridor. And the result shows that the highest spot speed measured at 40 feet segment in Burilia was 32.16 km/hr. where as the average spot speed was 34.81 km/hr of total three area. NDE gate are maximum speed 42.86 km/hr was observed in morning time where at minimum speed 33.45 km/hr was in the observed noon at a distance of 50 feet. Also we are found that Punchaboti maximum speed 37.36 km/hr in morning time and minimum speed 33.03 km/hr was in afternoon at a distance of 55 feet. In addition to spot speed analysis, we also measured the travel time along this corridor. Our data showed that the average travel time from Birulia to Punchaboti was 116.74 sec with the fastest travel time recorded at 80.24 sec and the slowest at 157.17sec. The highest speeds were observed during off-peak hours. On the other hand, travel time data showed that the average time taken to travel along the corridor ranged from 116.74 sec, depending on the distance and traffic conditions.

DECLARATION

We hereby attest that we are the sole author of this thesis and that no part of it, nor the entire thesis, has been submitted to any other university or institution for a degree. We certify that this project report, Spot Speed Analysis of Vehicular Traffic and Travel Time in Birulia to Dhour Corridor is done by us under the supervision of Mr. Rakibul Hassan, Associate Professor, Department of Civil Engineering, Daffodil International University. We are announcing that this project is our unique work, we additionally proclaim that this undertaking works are unique and have never been submitted in its entirety for any degree or diploma at this university.

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DEDICATION

We devote this work to almighty ALLAH first, also our parents and teachers for their deep amicable support and help.

CHAPTER 1: INTRODUCTION

1.1 General

Motorways in the Dhaka metropolitan area are the responsibility of traffic engineers, and they rely heavily on data on vehicle speeds and travel times in order to plan and operate the city's highways effectively. The methods used to compile and analyze the data, however, have an impact on its usefulness. This paper describes various approaches to analyzing spot read area of vehicle speeds and travel times, explores the relationship between speeds and travel times indicator km^2, sec, ft standard to preliminary data, proposes which techniques of analysis are best suited to the needs of the vehicle, and highlights in the chapter which techniques of analysis are best suited to the needs of the vehicle.

1.2 Background of study

Travel speed and vehicle movement is the effective speed of a vehicle traveling between three fixed places in a given location. It is calculated by dividing the distance traveled by the time it took for the vehicle to travel between the three sites, including any time spent at a halt. A stop-and-go state with forced acceleration and deceleration is present when the speed of travel is slower than running speed. Here, the local speed might be anywhere from a complete standstill to well above a jogging pace. Comfortable traveling circumstances are indicated by a consistency in running and travel speeds[1]. The current operational conditions are used for the travel speed investigation. Average The fundamental service metric for city streets is Travel Speed, which accounts for both the amount of time spent in motion while driving on a highway and the amount of time spent in traffic controls while moving over a distance[2].

Spot speed is a crucial measure for defining traffic conditions in the vehicle movement on the Baribadh, Mirpur Road in Dhaka city. The speed and quality of travel in a given distance may be estimated using this metric. Vehicle speed and vehicle flow are also crucial components of modern traffic management systems in Dhaka city, with the elimination of speeding and traffic signals. The speed, together with other criteria like traffic flow, reveals information about the present condition in the time spent traveling by vehicle. The assessment of travel time, including the

speed, is required for the dynamic transmission of trustworthy information to video record systems, and this problem also applies to local transportation (bus, motorbike, autocar, three whaler, and track). In order to anticipate potential alternate routes and save time, video recorders can be constantly updated about the expected arrival times of certain cars. It is also helpful for the transport operator to have information on the variation in travel times along the various segments of the Dhaka highway road network. Traffic modeling also has the issue of needing to make educated guesses about speed and travel time. The average speed for each kind and sub-type of connection and method of transportation should be accurately calculated in order to produce the most accurate depiction of traffic flows, occupancy of private parts of the distance, and examining the issue more generally travel behavior. Fixed travel durations are typically assumed for public transportation owing to scheduling, despite the fact that the speed of private transportation is extensively studied in the literature. The movement of these vehicles, including travel time, loss of time due to different causes, and also accounting for the stop service periods, must be included when examining techniques for measuring the average speed of public transportation vehicles. A link between these elements and the typical speed of the vehicle should be able to be formulated after their identification and analysis. In order to illustrate the difficulty of the estimate problem in traffic modeling, this study gives a statistical summary of the findings of research on travel times for mobile camera video systems (MCVS).

1.3 Objectives

The main objectives of the study are:

- To find out the spot speed and travel time of vehicles along Birulia to Panchoboti Corridor.

1.4 Problem Statement

Getting cars to slow down is a difficulty on the Bangladesh highway in a few designated areas because of spot speed and vehicular traffic. Due to Dhaka city's congested streets and narrow highways, these speed bumps play a crucial role in decreasing traffic accidents. How much speed is reduced depends on the length, height, and layout of the speed of spot distance. We identified the problem of different vehicle classes in Dhaka and calculated the range of possible travel times and speeds.

We've chosen three spots. The three sites were chosen based on their respective distances from Dhaka's Mirpur road (Baribadh).

The state of the roads is one such part of the road system. Reduced road safety is a direct result of pavement damage and wear and tear. The term "road roughness" refers to the degree to which the pavement has deteriorated. Due to its low cost to collect data, its ability to accurately represent road user expenses, and its general acceptance as the most relevant measure of pavement behavior, the Baribadh road area is by far the most popular pavement condition indicator. However, studying the dimensions of the road network alone is insufficient; it is also vital to examine the relationships between drivers and the surrounding environment[3]. Those who use motor vehicles in Bangladesh must adhere to a strict set of regulations. Due to the unique link between travel speed and the number and severity of collisions, the speed limit is one of the laws that is most often enforced. In this dissertation, the author looks at how different highway affect drivers' habits and performance, especially with regard to speed and other potential safety issues.

1.5 Significance of the Study

Speed is a crucial factor in a vehicle's safety, efficiency, comfort, and convenience. The length of time it takes to get from one location to another along a certain route is measured by travel speed studies. When possible, it's also helpful to note where and for how long delays occurred, as well as what caused them. The following are some of the applications of travel speed:

- Evaluation of Efficacy
- Rating data collection Model adjustment
- Acquire Information Useful for Economic Analysis (user costs)
- Comparison of old and new performance levels
- Situating the Source of the Issue

CHAPTER 2: LITERATURE REVIEW

2.1 Travel Times, Travel Speeds and Spot Speed

The evaluation of the degree of service provided by a highway segment has been the focus of travel time studies for a variety of reasons. Travel time is taken into account in the evaluation of a highway system because drivers frequently use the total amount of time it takes to get to their destination as a factor for picking a route.

- Travel time studies have a number of distinct goals, including:
- Locating the sources of traffic congestion,
- Estimating the number of vehicles expected to use a new infrastructure rather than an existing road
- Benefits to Road Users
- Various ratings and indices have been established to express delays. These ratings combine travel times and speeds with volumes and fluctuations in speeds. Their use is mostly limited to peak conditions.

The vehicle time-of-occupancy indicator was proposed by Zahu et al. (2011) [4]. This metric is calculated by dividing the average vehicle travel time by the number of vehicles passing through a certain stretch of highway in a given time frame. Congestion occurs when too many vehicles park in one area for too long. Studies conducted in the field found that the overall time spent in a vehicle rose proportionally with its volume while f reef lowing. Vehicle travel times increased as traffic jams worsened, yet volume levels stayed the same or even fell.

2.2 Methods of Field Measurement

Several methods have been used to measure travel times and delays. Each technique has its own advantages and shortcomings, and the selection of the appropriate method depends on the nature and the objectives of the study.

2.2.1 Travel Times

The license matching approach is a tried-and-true method of calculating travel times, and is frequently used as a benchmark against which other techniques are measured. Vehicle registration numbers and times of entry and exit from the test area are

recorded by observers. The distance a vehicle has traveled is equal to the difference between the values for that license plate. Due to the accounting for individual differences in driving styles, this method generates accurate travel times for cars traversing the teat portion. However, only total travel times are gathered; information on where and what caused delays, as well as halted times and running times, is not collected. Due to the need to verify license numbers and calculate travel durations, the process is very lengthy[5].

In the arrival-output approach, which is a subset of license matching, just the times at which cars arrive and exit the test region are kept[6]. The difference between the average vehicle entrance and exit times is the average travel time for the route. In situations when there are no entry or exit locations along the route, this method can be used to conduct a thorough examination[7].

Most typically, travel time data is gathered using the test-car technique. Between predetermined checkpoints, the test vehicle's average speed and total travel time are calculated. The test-car method can be carried out in one of three distinct ways. In the floating-car technique, for example, the driver is told to pass the same number of cars that go by him. This method works well on two-lane highways when traffic volumes are low and travel distances are substantial[8].

The average car method has shown to be more effective in achieving precise results. The driver is to maintain a speed that, in his judgment, is typical for the flow of traffic. The driver keeps track of the passing’s in his head, but he doesn't actively seek out passing opportunities every time another vehicle gets in front of him. Jain (2020 drew the following findings after contrasting the outcomes of the license matching technique with those of the two test-car procedures[9].

A practical measurement of the mean travel time and the mean over-all travel speed of vehicles in the traffic stream of heavily traveled signalized urban streets and heavily traveled two-lane rural highways can be provided by average test cars driven at speeds that, in the opinion of the drivers, are representative of the average speed of all traffic.

An observer often uses a stop watch to calculate travel times. In the experimental vehicle. In the event that further information is required, specialized measurement

instruments can be used. There is no longer a requirement for an observer to be present while using a speed and delay meter because this device has its own built-in printing and timing mechanism. The time, distance, and code number are all recorded when the driver presses a button. This algorithm pinpoints where and why delays occur[10].

The recording speedometer keeps track of the speed of the test vehicle in real time. In order to accurately record the vehicle's speed, the paper used to do so must move at a rate that is proportional to either the time or the distance traveled. The paper is moved in response to the vehicle speed using a different device called a traffic chronograph. Pen strokes on paper change with time. This technology is novel because it captures a visual representation of the test vehicle's variable speed.

2.3 Traffic Survey

Information on traffic is required by traffic engineers and planners. To plan and administer a road and traffic system, they require data. They utilize the data for economic analysis, prioritization, planning, and designing of traffic infrastructure, as well as for choosing geometric standards[11]. This is used to support the need for a warrant for traffic control equipment such signs, signals, pavement markings, and phone cameras. They utilize this data for a variety of purposes, including research on the efficacy of newly introduced schemes, diagnosis of problems and identification of viable remedies, projection of the outcomes of proposed methods[12], calibration and validation of traffic models, and so on. The transportation network is a living, evolving system. To keep up with the ever-changing transportation system, traffic data must be updated on a regular basis. To obtain reliable results, it is necessary to gather and evaluate data in a methodical fashion. In order to learn more about traffic, traffic surveys are conducted[10].

2.3.1 Traffic Speed Study

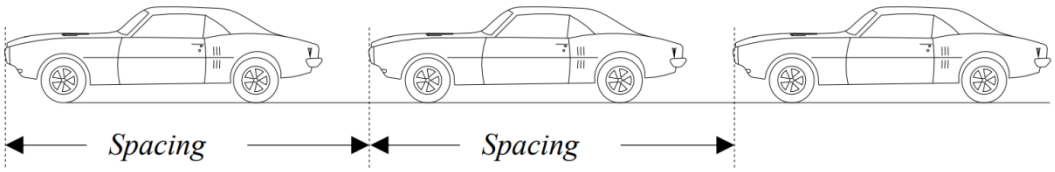
In addition to being used to set priorities and timetables for traffic improvements, traffic speed data are required during the research, planning, design, and regulation phases of traffic engineering. In order to establish distinct restrictions, such as passing sight distances and stopping sight distances, the traffic engineer must get an understanding of traffic speeds in general.

2.4 Traffic Flow Parameters and their relationships

Both speed and travel time parameters can be utilized to define traffic flows (considering traffic stream as a whole). Density, speed, and volume/rate of flow are macro-level factors, whereas spacing, headway, and other microscopic parameters are examples of traffic flow[13].

While spatial-temporal studies of traffic at the network level are the focus of this study, it is also appropriate to examine additional microscopic metrics at the level of individual connections and intersections. Because they apply to specific pairs of vehicles within traffic flows, headway and spacing are two properties of microscopic traffic flow. The spacing between cars in a traffic flow is measured from fixed sites on the vehicles themselves (e.g.; back wheel, front bumper, rear axle etc). The following diagram depicts a common scenario:

Figure 2.1: Distance between cars as determined by their front bumpers



Source:[10] Tahnin Tariq [14]

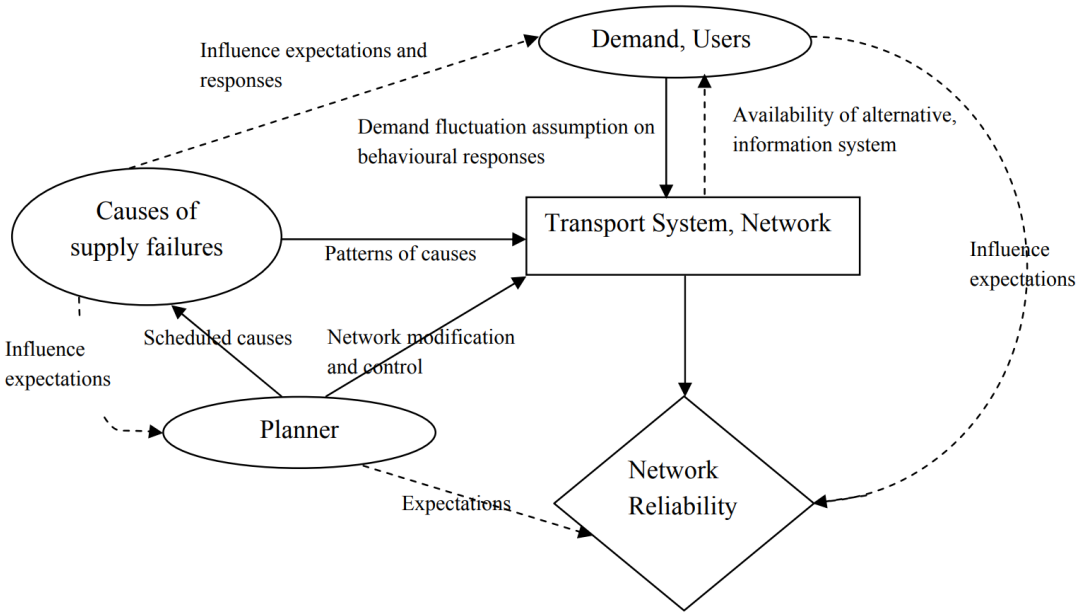
Time is represented by "headway," which is the interval between two subsequent vehicles as they pass a certain spot on a roadway and is measured using shared vantage points on each vehicle. Since a lot of data (headway, spacing, etc.) can be gathered for vehicle pairs in a relatively short amount of time, the utilization of these microscopic variables is extremely important in traffic flow analysis. Additionally, the aggregation of these factors has bearing on density.

2.5 The need for traffic analysis

According to Hossain (1996) [13] perspective, the primary mechanism that determines the state of a road network is the interactions that take place between the various components that make up the network, such as the demand and supply sides (for example, the link-flow volumes in the network). There may be differences in the link capabilities of networks brought about by the interaction of various components.

The many kinds of interactions are broken down into their essential components and presented in figure 2-5 down below. Under the heading of network performance indicators, a component of this diagram has been investigated in further depth. The interaction that results in various operational states of the network provides insight into how the network functions in response to demand by revealing differences in the link capabilities of networks. The many kinds of interactions are broken down into their essential components and presented in Figure 2.2down below. Under the heading of network performance indicators, a component of this figure has been investigated in further depth. The interaction that results in a variety of operational states for the network provides insight into how well the network meets the requirements of users.

Figure 2.2: Conceptual framework for the analysis of Vehicle network reliability



Source: Zafri et al. (2021)[15]

The effectiveness of road networks is an important factor that transport and traffic engineers as well as network operators focus a lot of emphasis on. It is preferable to have knowledge of the performance of the road network in the past, the performance of the road network in the present, and how its performance in the future may be planned to meet growing demand levels[16]. The evaluation of the performance of the network helps to establish whether or not the performance satisfies the strategic or operational goals that have been established. Network operators need to know, for the purposes of traffic analysis studies, whether or not they are achieving an effective

form of network use in relation to the capital investment they have made in the infrastructures that are being offered[17]. When traffic analysis is carried out, capacity enhancements to the road network may be planned effectively. To improve the effective passage of traffic on the network, traffic control methods can also be used. As a result, this will assist minimize congestion as well as emissions of pollution and other harmful substances, which will, in turn, aid the economy in some way[18].

2.6 Average Traffic Speed in Dhaka City

Table 2.1contains a comparison of the average speeds of vehicles traveling on three distinct kinds of roadways at four distinct timestamps.

Table 2.1: Average traffic speed comparison based on road types and timestamps

Road Type	Average Traffic Speed in Morning	Average Traffic Speed in Afternoon	Average Traffic Speed at Night	Average Traffic Speed at Midnight
Primary Roads	19 km/h	17 km/h	30 km/h	19 km/h
Secondary Roads	18 km/h	18 km/h	26 km/h	19 km/h
Tertiary Roads	18 km/h	17 km/h	29 km/h	18 km/h

Source: Sun et al. (2011) [19]

For all 25 routes taken into consideration,

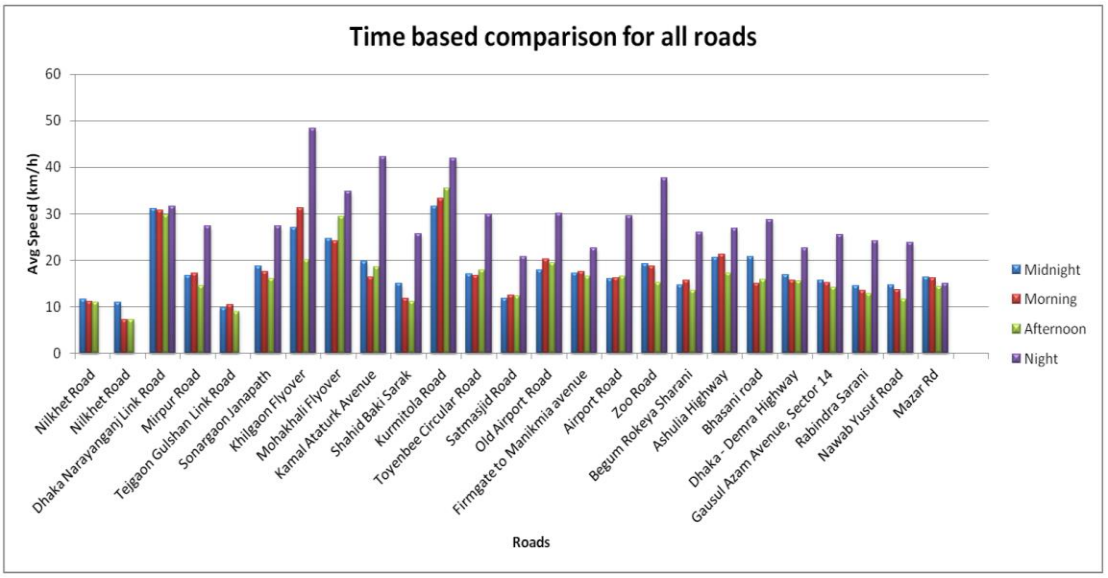


Figure 2.3 displays the timestamp-based traffic speed comparison. The majority of the roads have greater traffic speeds, which results in lower traffic intensity during the

night and midnight sessions and higher traffic intensity during the morning and afternoon sessions, it can be said. The slowest traffic and the prevalence of rickshaws are the main causes of problems on tertiary routes.

Source: Fardin (2022)

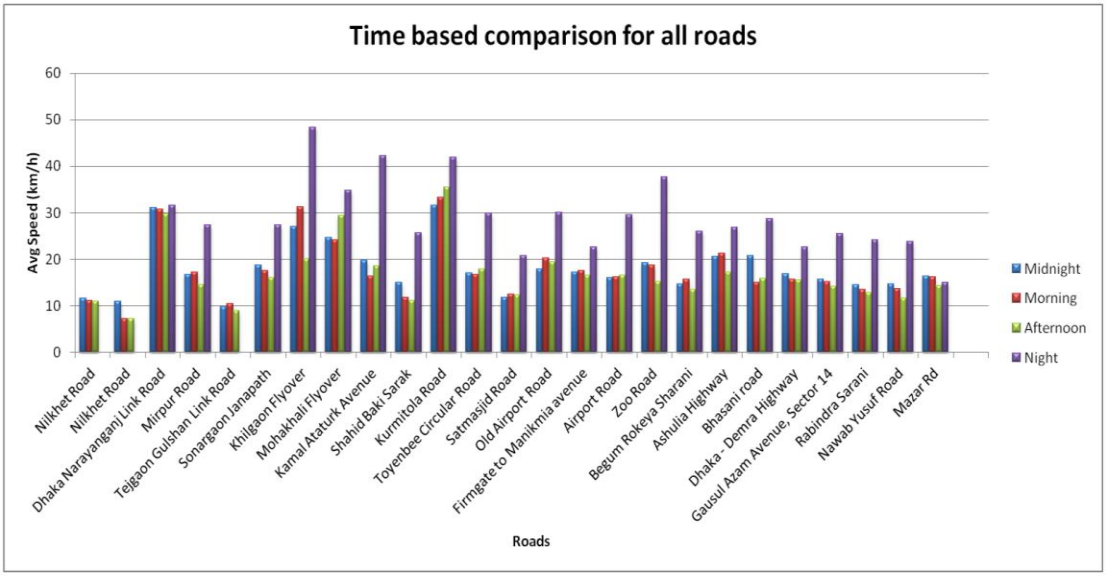


Figure 2.3: Time based comparison for all roads

One of the key factors in projecting traffic congestion, which has a significant impact on urban planning, is time-based average traffic speed analysis. The impact of various timestamps on the average speed of roadways is discussed in this article. Even though nighttime speeds are significantly greater than those recorded during other times of the day, several highways nonetheless see slower-than-usual traffic due to heavier volumes. The average speed on rickshaw-free routes is significantly greater than on roads where rickshaws are not allowed, according to the study's analysis. It follows that rickshaws and other slow vehicles have a significant influence in overall traffic congestion.

CHAPTER 3: MATERIALS AND METHODS

3.1 General

This chapter identifies the data requirements for the research. The types of data and how they were collected, which is essential to help provide answers to the research questions are discussed in this chapter. The devices that were used in collecting the data and how these data were validated have been made mentioned in the chapter as well. Useful information can be derived from data after it has been analyzed. A brief description of the analysis has therefore been made mention in the chapter.

3.2 Study Design

Prior to the analyses of the provided traffic and transport data a literature review was conducted regarding the research topic and research area and to get acquainted with practices and methods by previous researches that are in line with this research and the study area. Some of these researches include Public Transport, the comprehensive and cooperative approach of Mirpur Baribadh Road, Dhaka city, The area of Birulia Bus Stand, NDE gate, Panchaboti highway urban traffic patterns using random traffic vehicle capture, 2023.

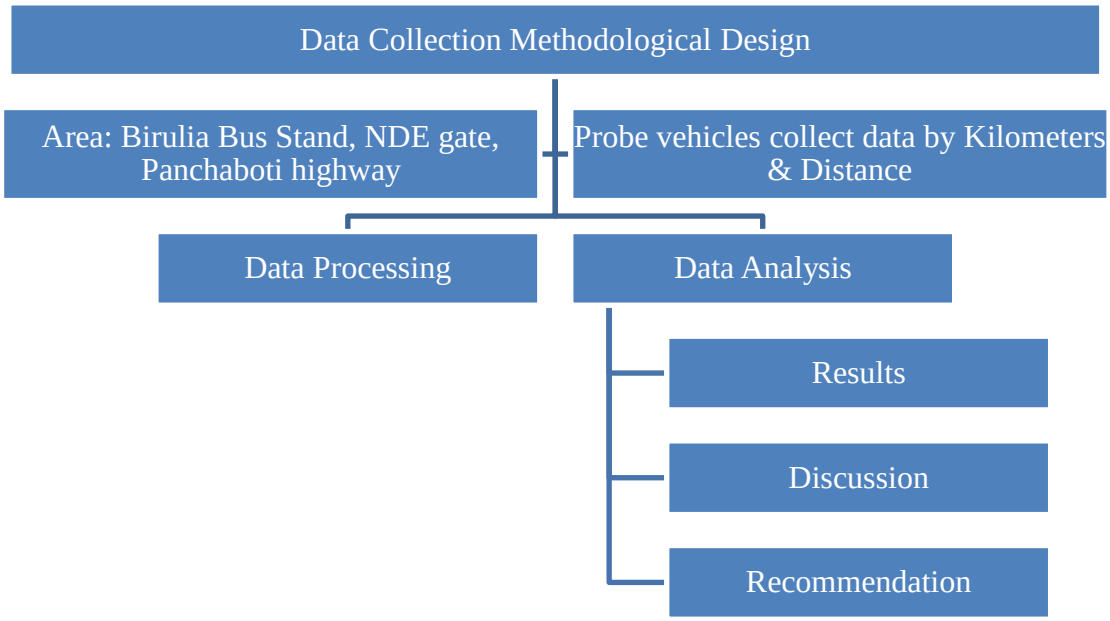


Figure 3.1: Methodological design framework

A methodological framework that looks at the steps taken to analyze the data in this

research was therefore devised and is shown top in Figure 3.1. Prior to the analyses of the provided traffic and transport data a literature review was conducted regarding the research topic and research area and to get acquainted with practices and methods by previous researches that are in line with this research and the study area. A methodological framework that looks at the steps taken to analyze the data in this research was therefore devised and is shown top in Figure 3.1.

3.2.1 Traffic Data Collection

Due to the nature of the information required from the data and the short time available, it was not possible to gather primary data personally for this study. For instance, traffic distance data from loop detectors had to be gathered at various area point points during specific periods[21] and at the same time, which was not feasible with human labor. The same holds true for velocity data gathered by probing vehicles.

For the traffic velocity data, speed profiles were created for the Mirpur Baribadh route by aggregating and analyzing GPS and mobile video readings from many devices that represent actual consumer driving behaviors. This consumer data was essential in determining realistic average highway speeds for different times of day and days of the week. Travel speeds on the Birulia bus station, NDE gate, and Panchaboti road network were determined for this study using Dhaka city's speed profile coverage for different nations at 10-minute intervals. This information was gathered using probe vehicles.

3.3 Study Area

In 1962, Mirpur Thana was founded. The Thana has one union porishod, eight wards, eleven mouzas, and eighty-six and twenty villages. During the British time (1757 to 1947), the Mirpur Thana (town) region was included in Keraniganj Thana, and during the Pakistan period, it was included in Tejgaon Thana (1947 to 1971). Mirpur achieved independence on January 31, 1972, following the Liberation War and Victory Day. The coordinates for Mirpur are 23.8042°N 90.3667°E. It is located in the north-east of Dhaka city and has a total size of 58.66 km2 (22.65 sq mi). Mirpur Beribadh (dyke) is a location in Dhaka, the Bangladeshi capital.

Figure 3.2: Study area overview

Source: Google Earth (2023)

3.4 Data Collection Point

We are the first spot point to choose the Birulia bus terminal, the Baribadh road, the speed measurements for the city of Dhaka, and the travel time for vehicles. This particular spot point's distances is measured using steel tape, and lime powder serves as an indicator and distances 0-40 feet. This is our working point on Tuesday, October 22, 2022, at nine o'clock in the morning, ten o'clock in the morning, one o'clock in the afternoon, and four o'clock in the afternoon. The timed distance of ten communities was monitored by a mobile phone camera and various types of vehicles. We have determined via GPS the position of the 40-foot roadway, which is at longitude 23.8489723 and latitude 90.3394099.

Figure 3.3: Birulia bus terminal, the Baribadh Road

Second, we have been allotted fifty feet at the NDE entrance in Birulia. The NDE gate highway road is always bustling with long-derived traffic, and the lengths between its various spot points are measured with steel tape and lime powder as indicators. For the sake of fine-tuning your GPS, the coordinates for that spot on the ground are 23°57'87.953″N and 90°25'7.435″E. This is our meeting place at 10 am and 11 am on Wednesday, October 5, 2022, and at 1 pm and 2 pm. Using a mobile phone camera and a variety of vehicles, the timed distances between 10 settlements were tracked.

Figure 3.4: NDE Gate, Birulia selected location point

Our last choice for Panchaboti, Birulia point, is 55 feet. Its GPS coordinates are 23.8601387"N and 90.3485219"N and the Panchaboti Highway is often used by local traffic. The lengths between its specific spot points are measured using steel tape, and lime powder is used as an indication. On Tuesday, October 6, 2022, from 10 to 11am in the morning, from 12.30pm to 1.30pm in the afternoon, and from 2.30 to 3.30 in the evening, this will be our focal point. A cell phone camera and various kinds of vehicles were used to track the timed distances between ten settlements.

Figure 3.5: Panchaboti highway road speed measures indicates

3.5 Calculating Method

Space-Mean- Speed is the weighted average of vehicle speeds based on how long they stay on the road segment. Mathematically, the measured speeds are the harmonic mean. It is provided by Salonen and Toivonen (2013) [23]:

$$u_s = \frac{1}{\frac{1}{N}\sum_{i=1}^{i=N}\frac{1}{U_i}}$$

Or,

$$\bar{u}_s = \frac{nd}{\sum_{i=1}^{i=n} t_1}$$

Where,

t_i = observed time for the i th vehicle to travel distance d

N or n = number of vehicles observed

d = length of roadway section

Time-Mean-Speed (TMS)

$$u_t = \frac{1}{\frac{1}{N}\sum_{i=1}^{n} U_i}$$

Or,

$$\bar{u}_t = \frac{\sum_{i=1}^{i=n} U_i}{n}$$

Where, U_i or u_i = observed speed of i-th vehicle N or n = number of vehicles observed.

There is a difference between space-mean speed and time-mean speed. Normal usage does not distinguish between the two speeds, but his calculations on traffic vehicles and travel time for theoretical and research reasons have revealed that:

$$u_t = u_s + \frac{\sigma_s^2}{\bar{u}_s}$$

where σ_s^2 = variance of the space distribution of speeds.

3.5.1 Design Speed

Design speed is defined as the maximum speed that can be maintained over a specified section of highway when conditions are so favorable that the design features

of the highway of selected three spot. This definition implies that the distance of speed should be selected based on drivers expectations, the type of highway. Table shows that distance of three location.

Table 3.1: Location wise distance

Spot Point Name	Distance
Birulia bus Stop, Baribadh Road	0-40 ft
NDE gate, Baribadh Road	0-50 ft
Panchaboti, Baribadh Road	0-55 ft

3.6 Used of Materials

3.6.1 Video Recorder

We conducted our experiments with an iPhone 11 Pro camera, which incorporates a third camera module, similar to the vehicle speed (telephoto). However, iPhone 11 (non-Pro) customers will still benefit from some of these new features. Please note that this post is not an official iPhone 11 Pro review. In the near future, we will publish a review with a DXOMARK Camera score. This next review will discuss the phone's overall photo and video capabilities, the new Night Mode, the ultra-wide angle camera, zoom performance, bokeh simulation in Portrait mode, and more. At this time, we wish to share our initial thoughts of the iPhone 11's new camera functionality.

Figure 3.6: Video Recorder Tools (iPhone recorder)

3.6.2 Tape measure

Its small form factor makes it convenient for on-the-go long-distance measurement and toolbox storage. Now that it's so widespread, you can even get a little version to keep on keyring. When conducting surveys, it is usual practice for professionals to utilize tape measures with a length of more than 100 meters. The blade is made of metal and is marked in linear increments; moreover, it has a protective sheath, a button that works as a stopper, a belt clip, an end hook, and a hand stripe. This instrument has become the de facto standard for many measuring applications. Its small form factor makes it convenient for on-the-go long-distance measurement and toolbox storage. Due to its immense success, it is currently being sold as a small keychain fob or novelty item.

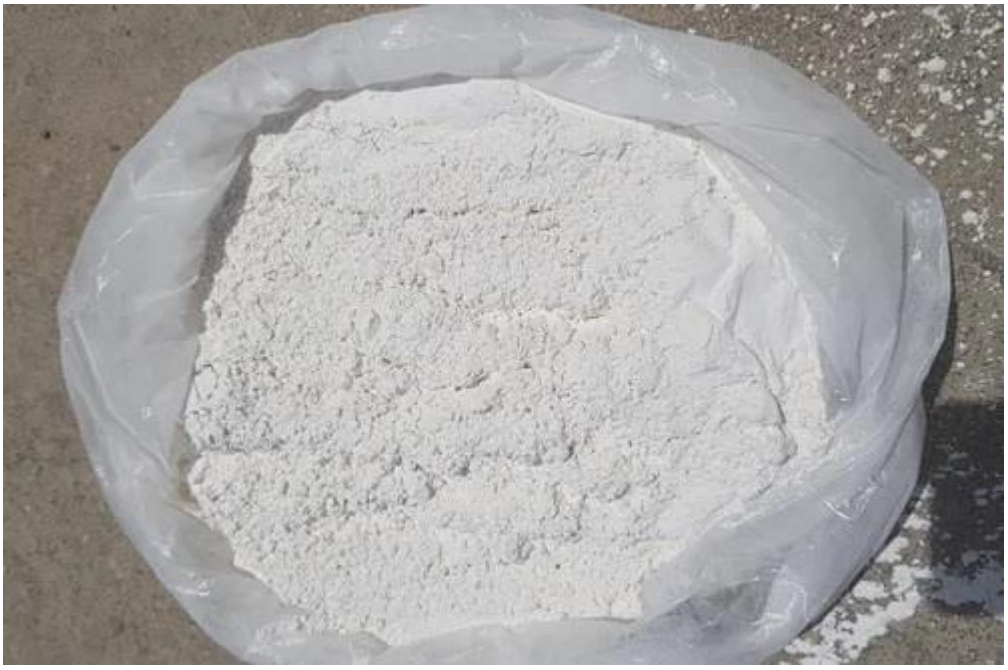
Figure 3.7: Steel Tape (Sample)

3.6.3 Lime Powder

Lime power is a distance measurement tool, and we employ it. Lime is an inorganic substance that contains calcium and is typically made up of oxides and hydroxide, most often calcium oxide and/or calcium hydroxide. Calcium oxide, found in coal-seam fires and in xenoliths of altered limestone found in volcanic ejecta, goes by this term as well. Lime, having the chemical formula CaO_2, is officially classified as a mineral by the International Mineralogical Association. As a result of lime's first application as a mortar, it carries connotations of staying there or adhering. Many of these products are still utilized extensively in a variety of industries, including construction and engineering (limestone products, cement, concrete, and mortar), chemistry, and sugar processing. Industries based on lime and the use of many of the

goods made from it can be traced all the way back to the ancient world, both in the Old World and the New World. In combination with ferrous sulfate, lime is a common treatment for wastewater.

Figure 3.8: Lime power (Sample)



3.6.4 Paint Spray

Spray painting is a method of painting in which a coating substance (paint, ink, varnish, etc.) is applied to a surface by being sprayed onto it at high speed via the air from a device. Most popular models rely on a pressurized gas, often air, to atomize and guide the paint particles. Spray guns are an offshoot of airbrushes; the two are often differentiated by the size of the spray pattern each creates. An airbrush is a handheld painting tool that may replace a brush in precise applications including photo retouching, nail art, and fine art. Spraying using an air pistol requires more substantial machinery. The technique is commonly employed when a uniform coating of liquid must be applied to a big area. Automated or manually operated, spray guns include interchangeable nozzle heads for a variety of spray patterns. Aerosol paint cans that only contain one color are convenient both for use and for storage.

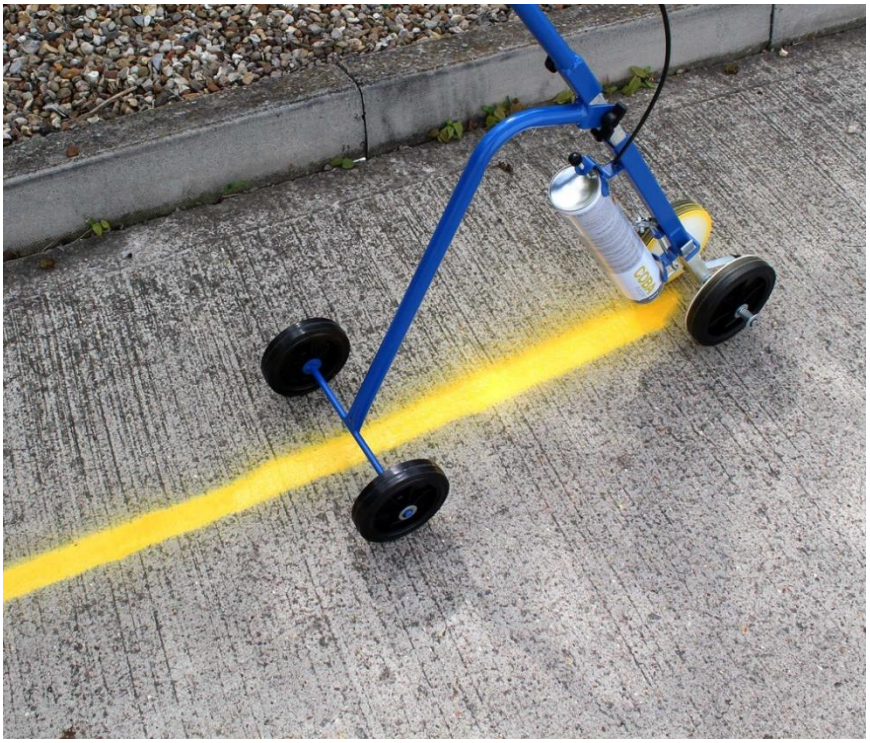


Figure 3.9: Paint spray (sample)

3.6.5 Smartphone Distance Application

We mostly utilized the iPhone 11Pro since it is the greatest smartphone for taking portraits and capturing high-quality image. The research area's vehicle speed was measured using a smartphone as a runner-up.

CHAPTER 4: DATA ANALYSIS AND RESULTS

4.1 Introduction

Many different methods of vehicle travel speed and distance evaluations are described in this chapter. Trip speed research includes all three of those areas. The process of collecting and analyzing the volume statistics has been described in great depth. The speed profiles were used to calculate the average speeds and the percentage of free flow speed for each road segment. The study describes the speed-volume correlations for the entire and for certain parts of Dhaka. Analyses' results have been supplied and will be discussed in a subsequent section.

4.2 Spot Speed Analysis of Birulia Bus Stand, Baribadh Road

Table 4.1reveals maximum speed found on 38.62 (km/hr) of three wheeler and minimum speed 29.28 (km/hr) on the total vehicle 24 and there average speed 31.76 (km/hr) in 40 ft distance.

Table 4.1: Birulia Bus Stand, 1st Day (Morning Shift) (9:00am-11:00am)

Vehicle Type	Vehicle No.	Time (sec)	Speed (km/hr)
Bus	4	1.74	29.28
Truck	5	1.50	31.64
Motorbike	5	1.45	32.53
Automobile	5	1.46	32.44
Three Wheeler	5	1.23	38.62
Total/Avg.	**24**	**1.53**	**31.76**

Distance = 40 ft

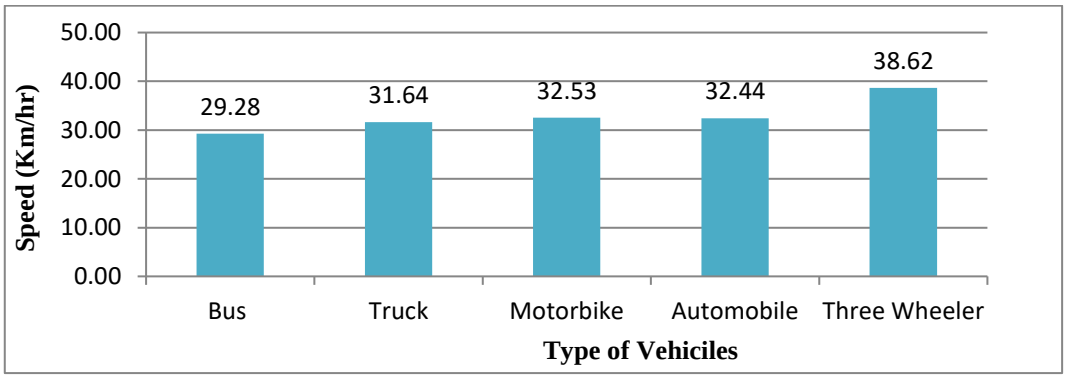


Figure 4.1: Birulia Bus Stand, 1st Day (Morning Shift) (9:00am-12:00am)

Table 4.2 shows that the highest speed of a car or motorcycle was 35.11 km/hr, and the lowest speed was 24.89 km/h. The average speed of all 25 vehicles was 32.16 km/h over a distance of 40 ft.

Table 4.2: Birulia Bus Stand, 1st Day (Noon Shift) (1:00pm-3:00pm)

Vehicle Type	Vehicle No.	Time (sec)	Speed (km/hr)
Bus	5	1.60	33.65
Truck	5	1.82	24.89
Automobile	5	1.40	35.11
Motorbike	5	1.40	35.11
Three Wheeler	5	1.48	31.50
Total/Avg.	25	1.55	32.16

Distance = 40 ft

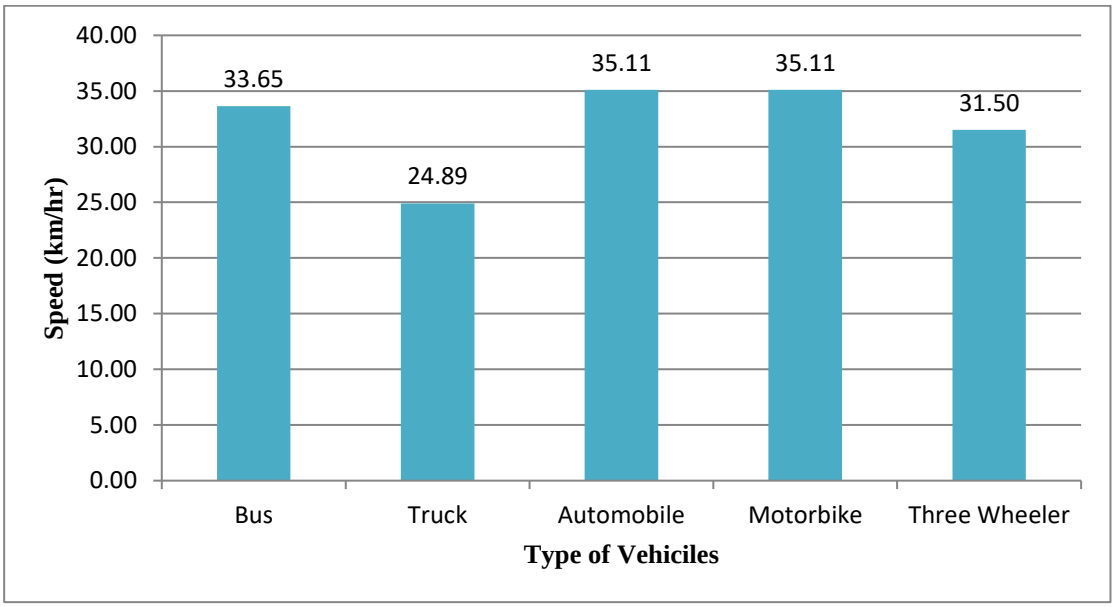


Figure 4.2 Birulia Bus Stand, 1st Day (Noon Shift) (1:00pm-3:00pm)

Table 4.3 reveals maximum speed found on 35.24 km/hr of motorbike and minimum speed 24.89 (km/hr) on the total vehicle 25 and there average speed 31.06 km/hr in 50 ft distance.

Table 4.3: Birulia Bus Stand, 1st Day (After Noon Shift) (4:00pm-6:00pm)

Vehicle Type	Vehicle No.	Time (sec)	Speed (km/hr)
Bus	5	1.60	29.47
Truck	5	1.82	24.89
Automobile	5	1.18	33.98
Motorbike	5	1.72	35.24
Three Wheeler	5	1.14	35.02
Total/Avg.	**25**	**1.56**	**31.06**

Distance = 40 ft

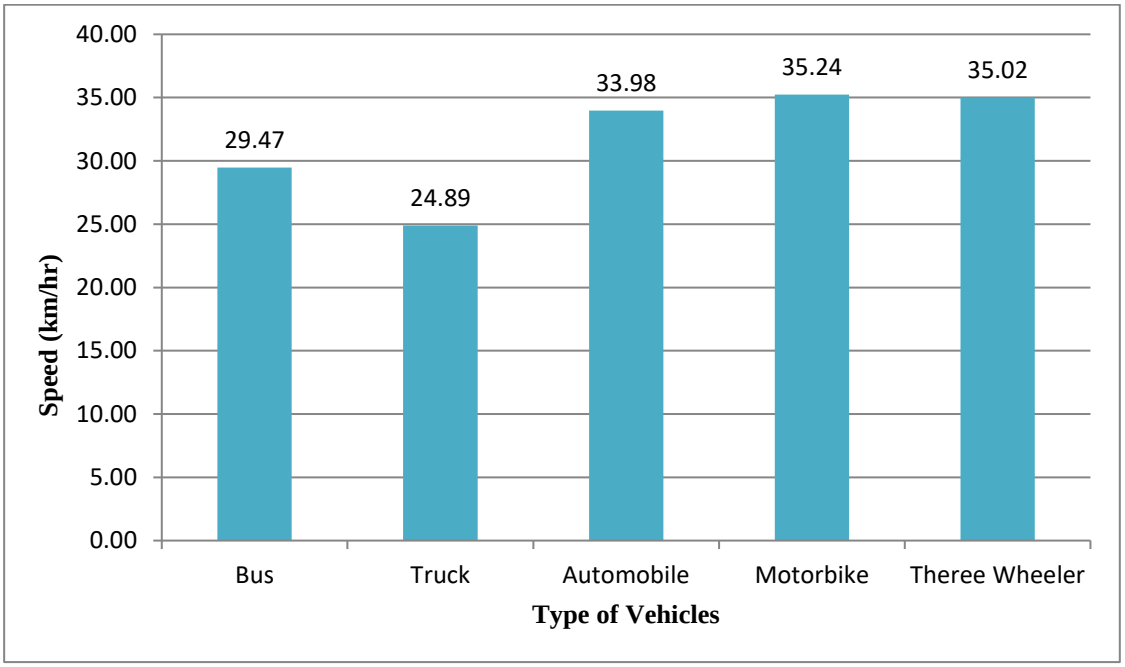


Figure 4.3: Birulia Bus Stand, 1st Day (After Noon Shift) (4:00pm-6:00pm)

4.3 Spot Speed Analysis of NDE Gate, Baribadh Road

Table 4.4 shows that the greatest speed found on the motorbike was 46.90 km/hr, the minimum speed was 36.88 km/hr, and the average speed was 42.86 km/hr in a 50-foot distance.

Table 4.4: NDE Gate, 2nd Day (Morning) (9:00am-11:00am)

Vehicle Type	Vehicle No.	Time (sec)	Speed (km/hr)
Bus	5	1.42	41.69
Truck	5	1.58	36.88
Automobile	5	1.26	45.83
Motorbike	5	1.20	46.90
Three Wheeler	5	1.28	43.76
Total/Avg.	25	1.36	42.86

Distance = 50 ft

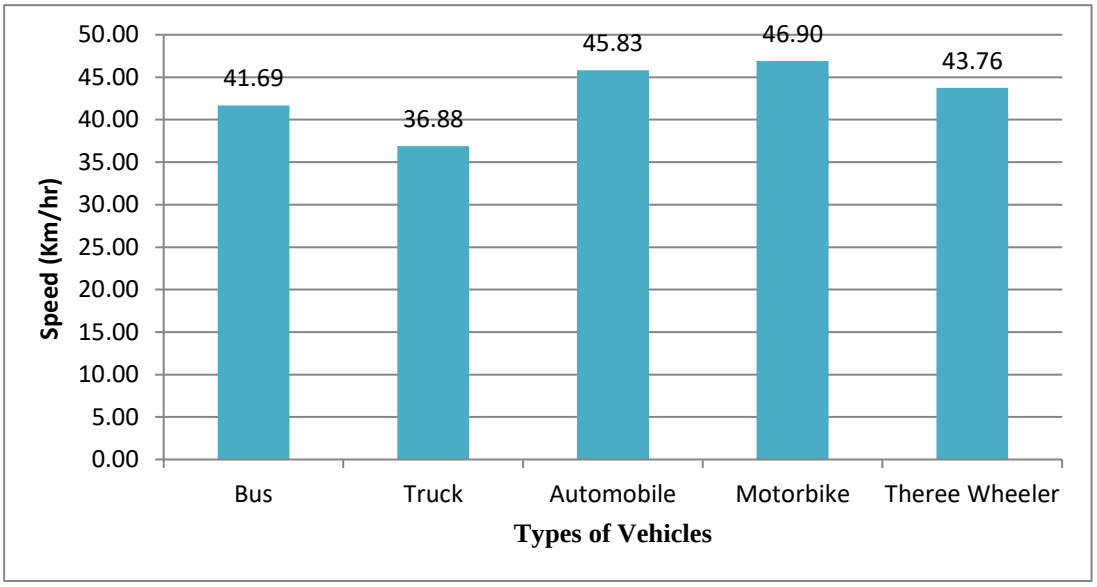


Figure 4.4: NDE Gate, 2nd Day (Morning) (9:00am-11:00am)

Table 4.5 reveals maximum speed found on 37.13 km/hr of motorbike and minimum speed 28.11 km/hr on the total vehicle 25 and there average speed 33.45 km/hr in 50 ft distance.

Table 4.5: NDE Gate, 2nd Day (Noon) (1:00-3:00)

Vehicle Type	Vehicle No.	Time (sec)	Speed (km/hr)
Bus	5	1.80	34.28
Truck	5	1.72	28.11
Automobile	5	1.74	33.99
Motorbike	5	1.58	37.13
Three Wheeler	5	1.76	35.23
Total/Avg.	**25**	**1.71**	**33.45**

Distance = 50 ft

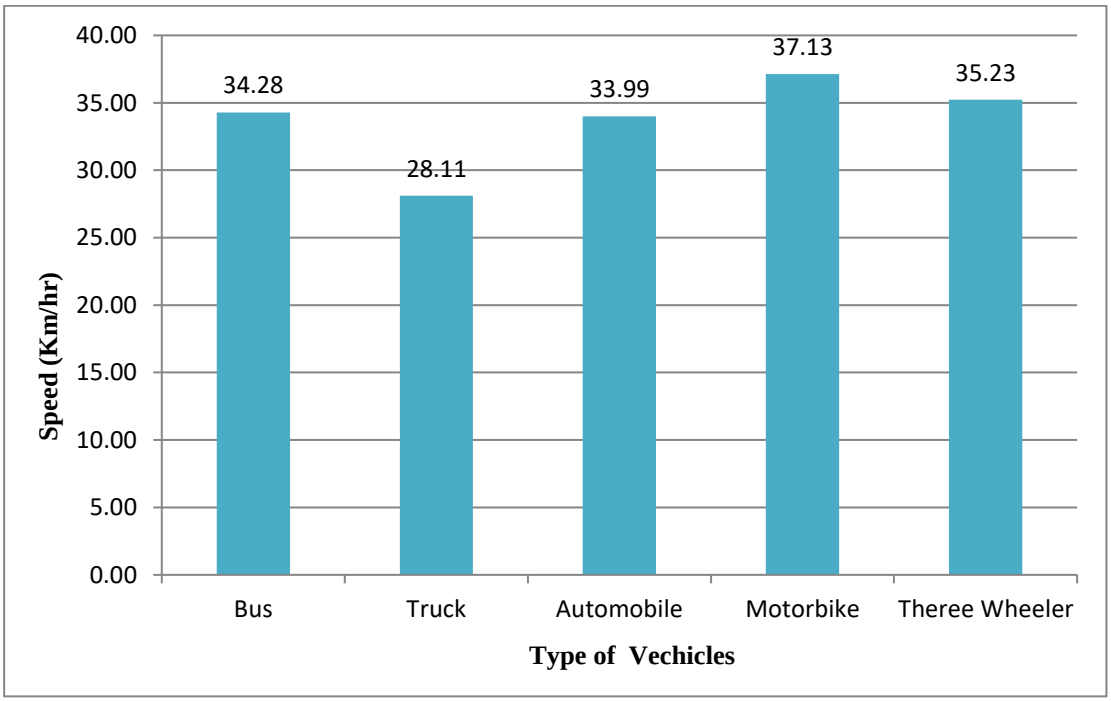


Figure 4.5: NDE Gate, 2nd Day (Noon) (1:00-3:00)

Table 4.6 indicates the highest speed of a truck to be 39.26 km/h, the minimum speed to be 28.35 km/h, and the average speed to be 35.22 km/h over a distance of 50 feet.

Table 4.6: NDE Gate, 2nd Day (After noon) (4:00pm-6:00pm)

Vehicle Type	Vehicle No.	Time (sec)	Speed (km/hr)
Bus	5	2.01	28.35
Truck	5	1.58	39.26
Automobile	5	1.56	38.51
Motorbike	5	1.72	35.24
Three Wheeler	5	1.76	32.22
Total/Avg.	**25**	**1.72**	**35.22**

Distance = 50 ft

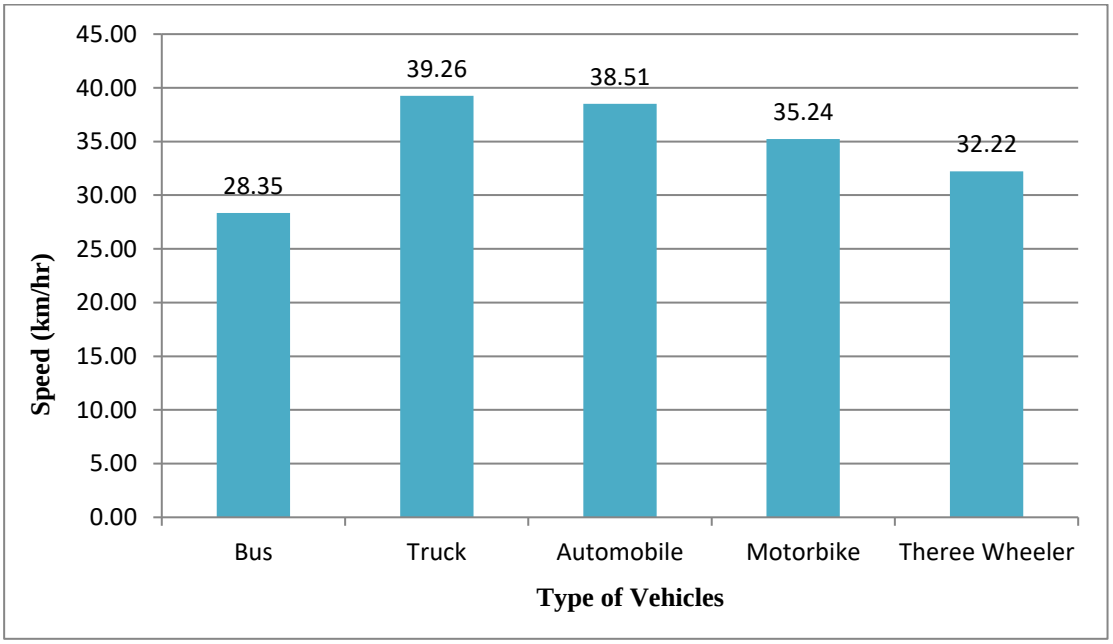


Figure 4.6: NDE Gate, 2nd Day (After noon) (4:00pm-6:00pm)

4.4 Spot Speed Analysis of Panchaboti, Baribadh Road

Table 4.7 reveals maximum speed found on 44.05 km/hr of motorbike and minimum speed 33.38 km/hr on the total vehicle 25 and there average speed 37.36 km/hr 55 ft distance.

Table 4.7: Panchaboti, 3rd Day (Morning) (9:00am-11:00am)

Vehicle Type	Vehicle No.	Time (sec)	Speed (km/hr)
Bus	5	1.76	36.33
Truck	5	1.86	33.38
Automobile	5	1.80	34.89
Motorbike	5	1.44	44.05
Three Wheeler	5	1.66	42.04
Total/Avg.	**25**	**1.71**	**37.36**

Distance = 55 ft

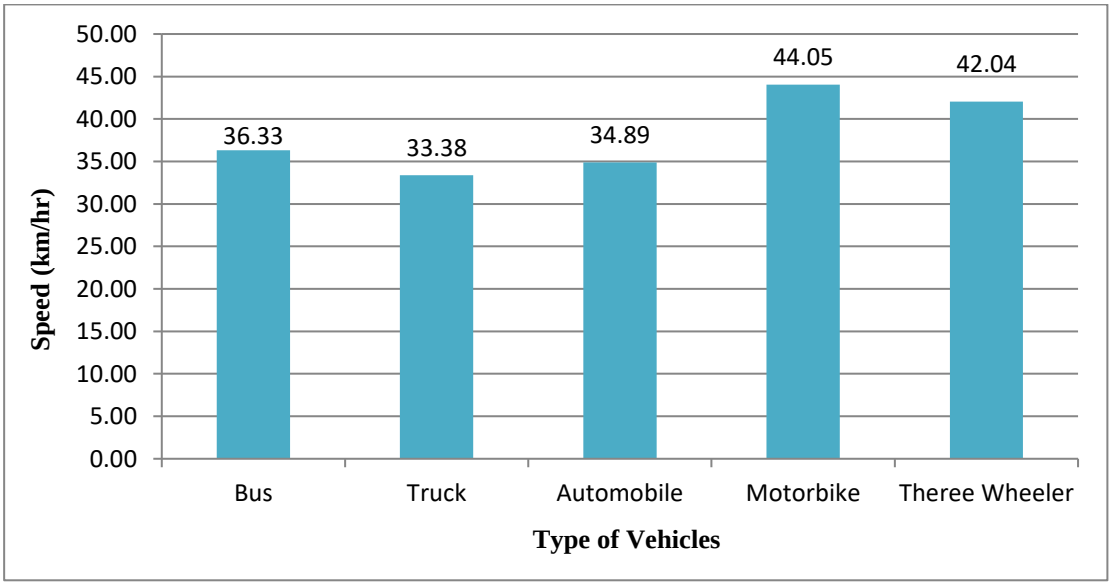


Figure 4.7: Panchaboti, 3rd Day (Morning) (9:00am-12:00am)

Table 4.8 indicates the highest speed of a motorcycle to be 40.43 km/h, the minimum speed of all 25 vehicles to be 29.66 km/h, and their average speed over a distance of 55 feet to be 36.36 km/h.

Table 4.8: Panchaboti, 3rd Day (Noon) (1:00-3:00)

Vehicle Type	Vehicle No.	Time (sec)	Speed (km/hr)
Bus	5	2.05	29.66
Truck	5	1.86	33.73
Automobile	5	1.60	40.35
Motorbike	5	1.60	40.43
Three Wheeler	5	1.76	37.22
Total/Avg.	25	1.77	36.36

Distance = 55 ft

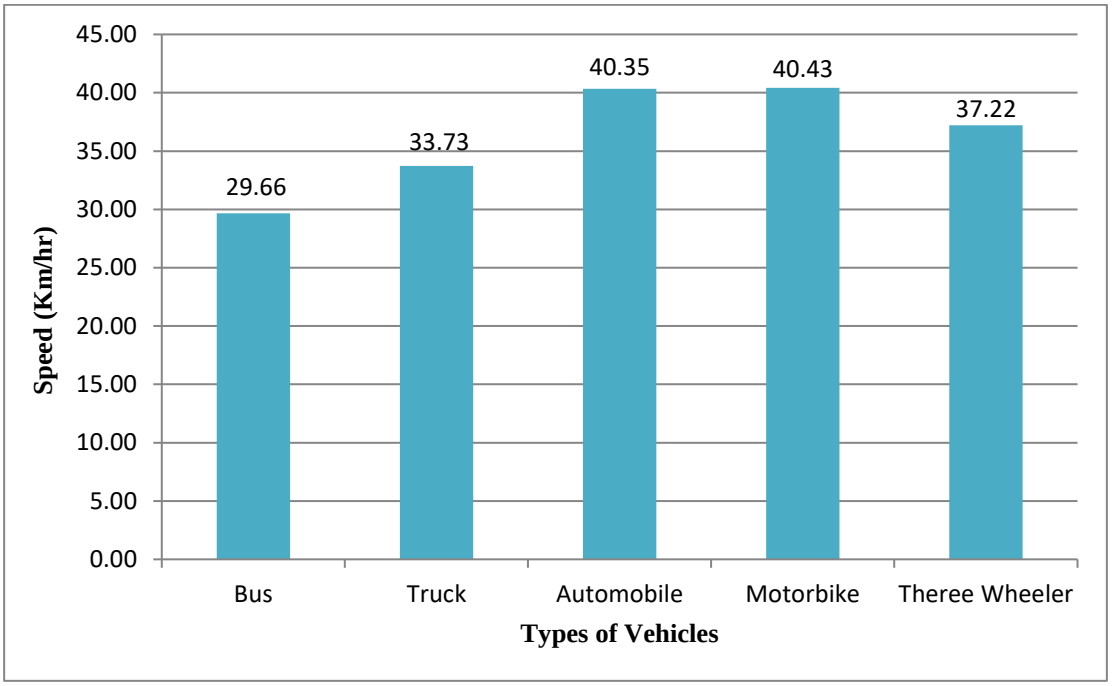


Figure 4.8: Panchaboti, 3rd Day (Noon) (1:00-3:00)

Table 4.9 reveals maximum speed found on 34.60 km/hr of motorbike and minimum speed 25.14 km/hr on the total vehicle 25 and there average speed 33.03 km/hr in 55 ft distance.

Table 4.9: Panchaboti, 3rd Day (After Noon) (4:00-6:00)

Vehicle Type	Vehicle No.	Time (sec)	Speed (km/hr)
Bus	5	2.50	25.14
Truck	5	1.68	38.39
Automobile	5	1.94	32.44
Motorbike	5	1.82	34.60
Three Wheeler	5	1.92	34.35
Total/Avg.	25	1.96	33.03

Distance = 55 ft

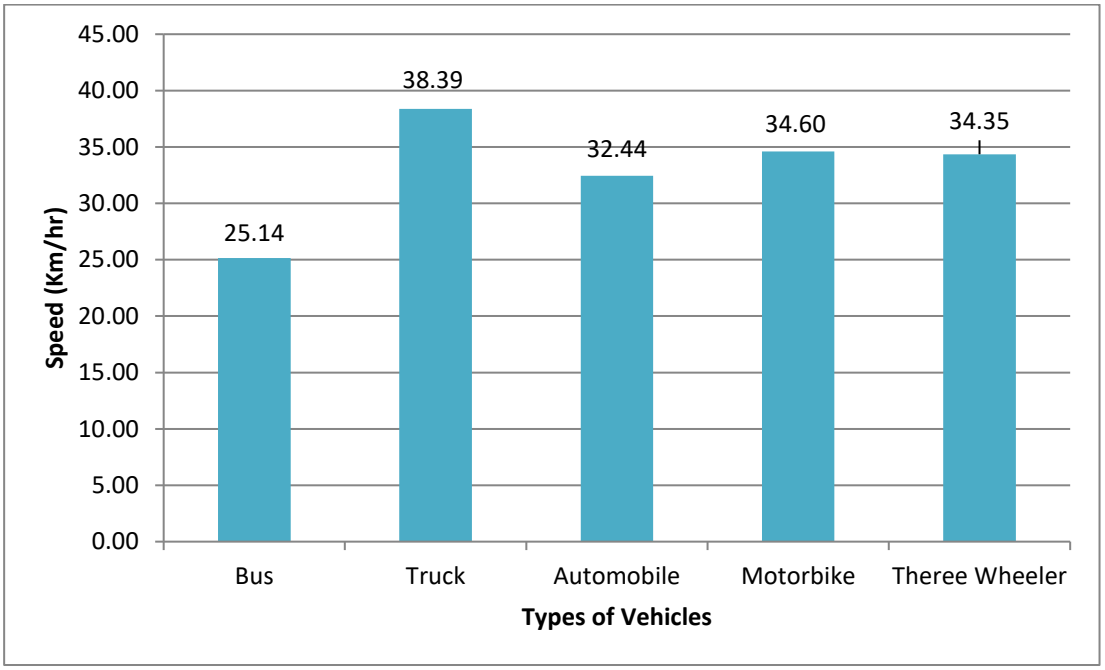


Figure 4.9: Panchaboti, 3rd Day (After Noon) (4:00pm-6:00pm)

4.5 Speed Comparison of Three Spot Point

Maximum speed measured in a three-day test at 40 feet apart was 32.16 kilometers per hour in Birulia at midday on the first day of the test, according to the data in **Error! Reference source not found.** . During the morning rush hour, the record s peed was set at 42.86 kilometers per hour at NDE gate, while on the third day, the record speed was 37.36 kilometers per hour at Panchaboti, at a distance of 55 feet. Maximum speed was measured at 42.86 km/h in the NDE gate, the slowest of the three measured locations on Baribadh Road in Dhaka.

Table 4.10: Speed Comparison of Three Spot Point

	Spot Point	Total Vehicle	Distance (ft)	Time (sec)	Speed (km/hr)
Birulia 1st Day	Morning	24	40	1.53	31.76
	Noon	25	40	1.55	32.16
	After noon	25	40	1.56	31.06
NDE Gate 2nd Day	Morning	25	50	1.36	42.86
	Noon	25	50	1.71	33.45
	After noon	25	50	1.72	35.22
Panchaboti 3rd Day	Morning	25	55	1.71	37.36
	Noon	25	55	1.77	36.36
	After noon	25	55	1.96	33.03
3 days Total Avg.		**224**	**48.33**	**1.65**	**34.81**

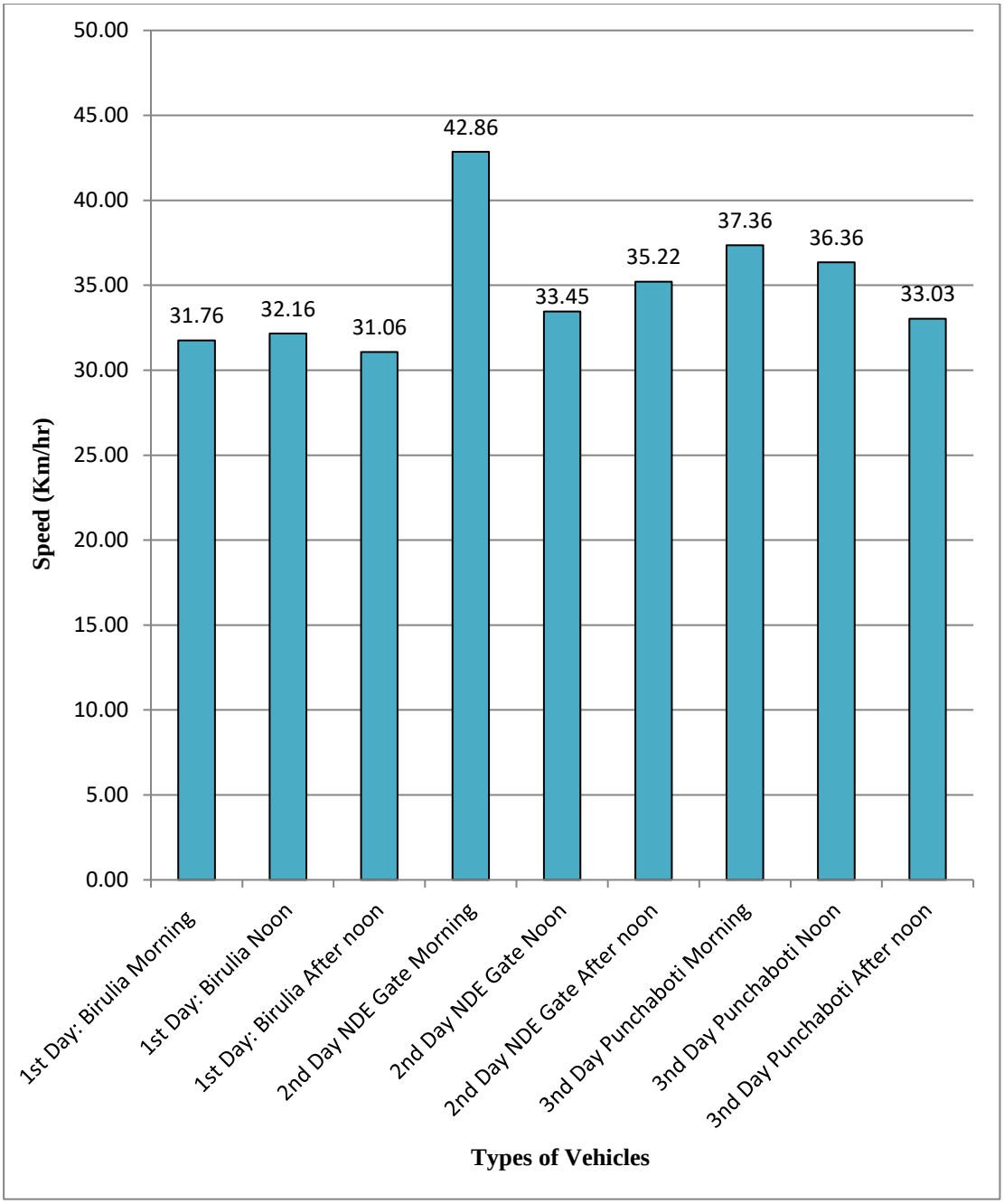


Figure 4.10: Spot Point wise Comparison

4.6 Travel Time Analysis of Panchaboti to Birulia Bus Stand, Baribadh Road

Figure 4.11 showed that the least traveling speed recorded on a motorbike was 106.2 seconds of whole 1 kilometer (3281 ft) area, Panchaboti to Birulia bus stand. This was compared to the highest length of 122.8 seconds for a three wheeler going at 29.91 kilometers per hour, which was 122.8 seconds.

Length = 3281 ft (1km)

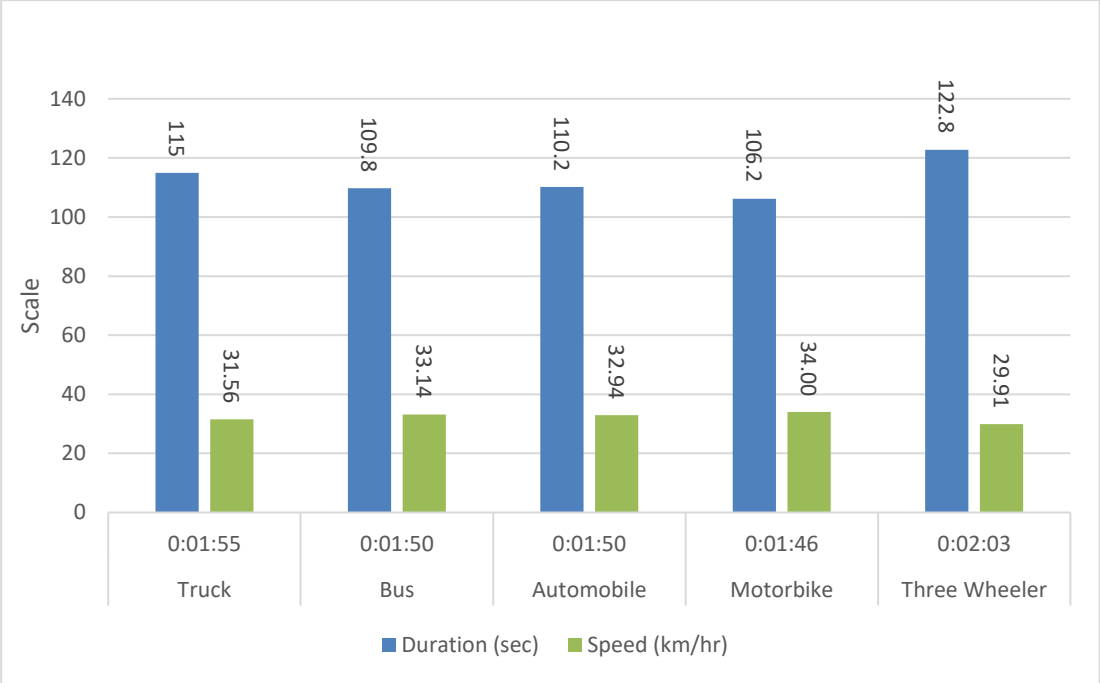


Figure 4.11: Travel Time Analysis of Morning Shift (9:00am-11:00am)

Length = 3281 ft (1km)

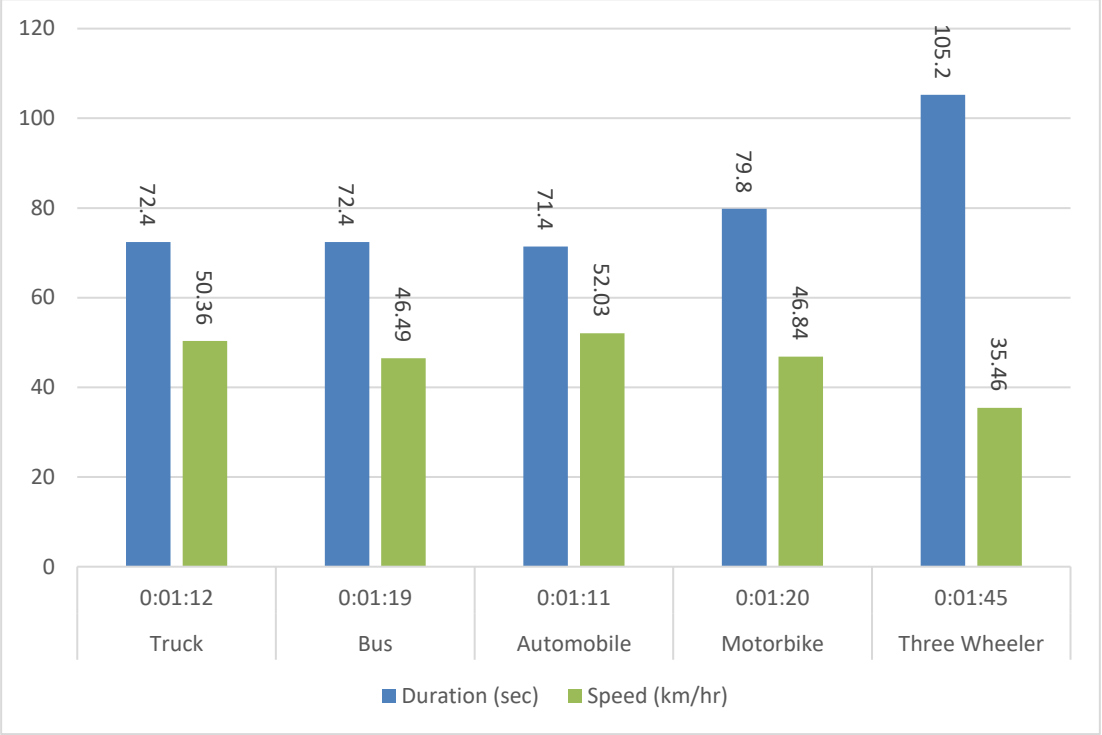


Figure 4.12: Travel Time Analysis of Noon Shift

Length = 3281 ft (1km)

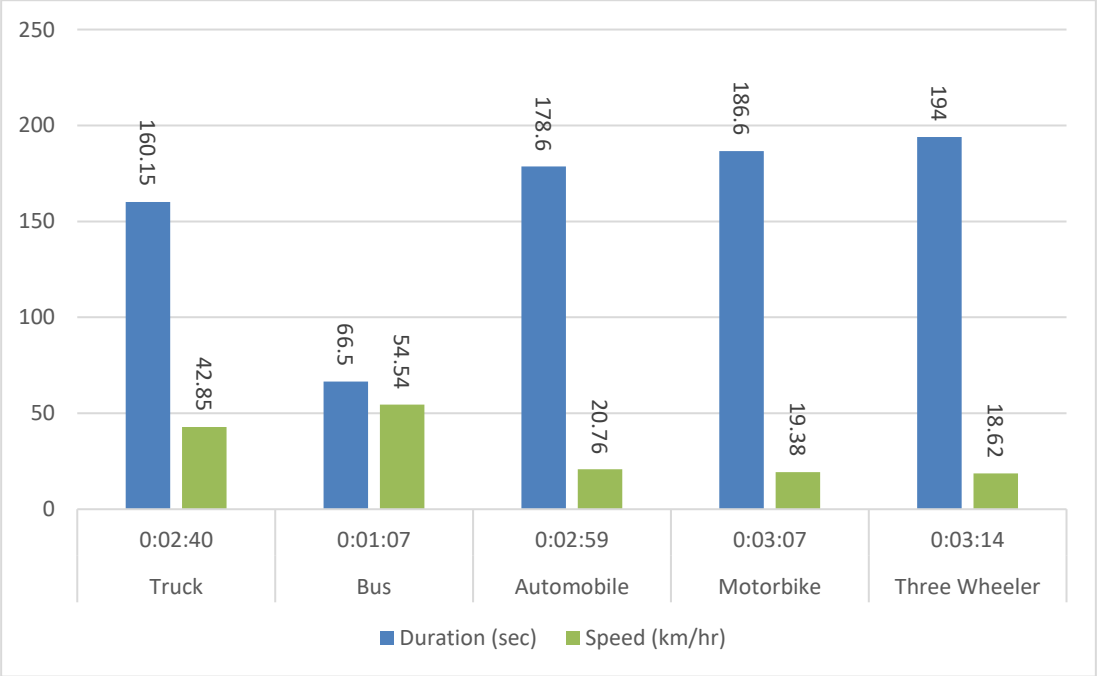


Figure 4.13: Travel Time Analysis of After Noon Shift

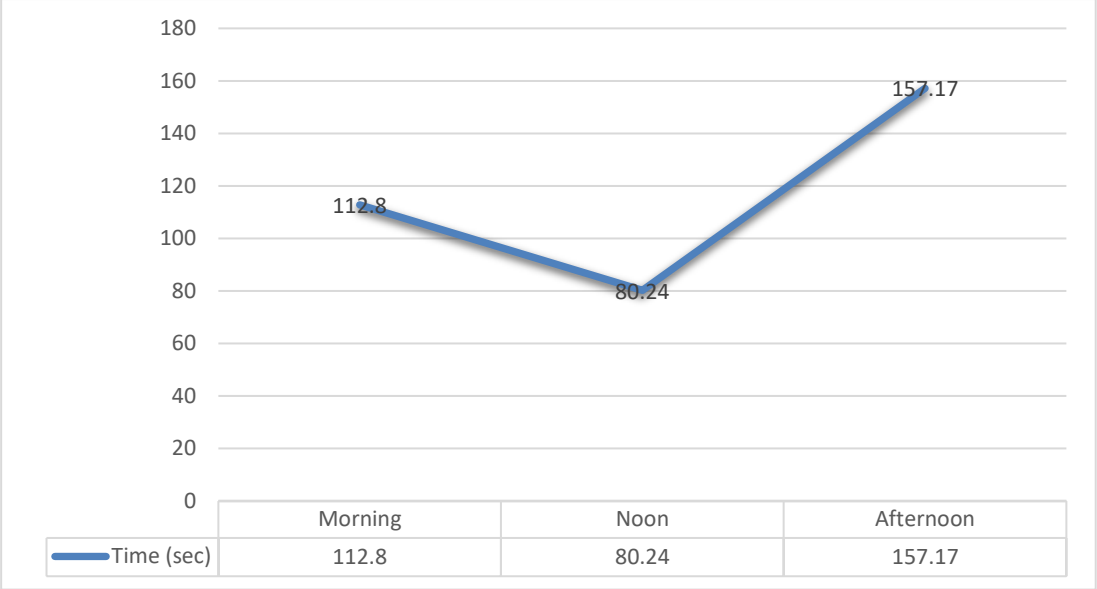


Figure 4.14: Scheduled based Travel Time Comparison

4.7 Scheduled based Travel Time Comparison

Figure 4.14 showed that maximum 46.23 ft/sec speed in noon time with compared 36.31 ft/sec in morning time. Lowest duration found 80.24 sec in noon scheduled and maximum 157.17 in after-noon travelling time. We are recorded maximum speed 42.13 km/hr in noon travelling time of vehicular, least time 28.46 km/hr in after noon of three scheduled in 1 kilometer of Panchaboti to Birulia area, Dhaka city.

CHAPTER 5: DISCUSSION

5.1 Findings

The analysis of spot speed data revealed that the average speed of vehicular traffic in the Birulia to Panchaboti corridor ranged from 20-40 km/h, depending on the time of day and location. The highest speeds were observed during off-peak hours. On the other hand, travel time data showed that the average time taken to travel along the corridor ranged from 116.74 sec, depending on the distance and traffic conditions. The highest travel times were observed during peak hours and on sections of the road with heavy congestion.

5.2 Discussion

Table 4.1 displays that the average speed of all vehicles on Birulia roads on the first day was 31.76 km/hr, with three-wheelers averaging a higher speed of 38.62 km/hr. The Birulia road had a higher average vehicular traffic spot speed compared to other roads due to lower traffic volume. However, there was significant variation in recorded speeds, as indicated by the standard value of 32.16 km/hr on average (Table 4.2). One possible explanation is the use of the NDE gate highway by both township shuttles and long-distance travelers, as well as a large concentration of big vehicles on the road that affects its speed characteristics. The other highways had a smaller range of speeds (28.11 km/hr for trucks) and a faster average spot speed (37.13 km/hr) in Table 4.8, as they primarily support township transport. The NDE gate, with traffic calming 50 ft intervals and a maximum truck speed of 39.26 km/hr (Table 4.10), was more disrupted than Panchaboti roads, which had similarly low spot speeds. The spot speed for motorbikes at the Panchaboti bus stand during the morning was 44.05 km/hr (Table 4.13). This road is an intercity thoroughfare with a small number of heavy trucks and crisscrossed by several intersections. Table 4.15 indicates the highest motorcycle speed at 40.43 km/h, the lowest speed of all 25 vehicles at 29.66 km/h, and their average speed over 55 feet to be 36.36 km/h.

The statistics in Table 4.18 show that the maximum speed recorded at 40 feet in Birulia on the first day was 32.16 km/hr, while the top speed on day three was 37.36 km/hr at Panchaboti, 55 feet away. On day one, during rush hour, the NDE gate recorded the highest speed at 42.86 km/hr, the slowest of the three monitored points on Dhaka's Baribadh Road. The traffic stream on Birulia bus stand had no limited speed, unlike the multimodal spot speed distribution pattern observed on the route.

Figure 4.11 summarizes the most important data from the travel time analysis. Three-wheelers had a significantly higher speed of 29.91 km/hr, taking 122.8 seconds. The slowest speed recorded for a truck, bus, or car was 72.4 seconds from Panchaboti to Birulia bus terminus, covering about 1 kilometer, as shown in Figure 4.13. This was longer than the best time for a three-wheeler going at 35.46 km/hr, covering 32.31 feet per second in 105.2 seconds. Panchaboti to Birulia serves three spot point travel demand and interstate traffic flow, resulting in a multimodal pattern caused by a homogeneous traffic stream with different travel speeds.

CHAPTER 6: CONCLUSION

The study aimed to conduct a spot speed analysis of vehicular traffic and measure travel time in the Birulia to Dhour corridor. The results of the study showed that the highest spot speed of vehicular traffic in the selective points was 42.86 km/h and the lowest at 31.06 km/h.

In addition to spot speed analysis, we also measured the travel time along this corridor. Our data showed that the average travel time from Birulia to Panchaboti was 116.74 sec with the fastest travel time recorded at 80.24 sec and the slowest at 157.17sec.

Based on the results, it can be concluded that the Birulia to Panchaboti corridor experiences moderate vehicular traffic, with spot speeds and travel times. The study findings can be used by transportation authorities and planners to optimize traffic flow and improve travel times in the corridor.

6.1 Limitation

1. The work was performed manually, resulting in inaccurate data collection.
2. The use of a mobile camera to capture videos introduces challenges in accurately measuring the speed of large vehicles.
3. The absence of digital devices further complicates the determination of travel time. Additionally, limited team members posed challenges during the data collection process.

6.2 Recommendation

The research findings provide valuable insights for improving road safety in the Birulia to Dhour corridor, leading to the following recommendations:

1. This task can be easily achieved by utilizing a digital vehicle speedometer.
2. The effectiveness of performing the task can be greatly improved by having a larger team.
3. The ability to cover a wider area can be facilitated by gathering extensive data.
4. Detailed information regarding the expected vehicles and their travel schedules will be obtained through data collection efforts this year.

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APPENDIX-I: RAW DATA

Table 1: Spot Speed Data

1st Day: Birulia Morning [Link: https://youtu.be/Upcr7U1LXLQ]

Vehicle Type	Total Vehicle	Distance (ft)	Time (sec)	Speed (km/hr)
Bus	4	40	1.74	29.28
		40	1.20	36.89
		40	2.00	21.94
		40	3.00	14.63
		40	1.00	43.89
		40	1.50	29.05
Truck	5	40	1.50	31.64
		40	1.00	43.89
		40	2.00	21.95
		40	1.30	33.53
		40	2.00	21.95
		40	1.20	36.89
Motorbike	5	40	1.45	32.53
		40	2.00	21.95
		40	1.00	43.89
		40	1.21	35.57
		40	1.06	39.29
		40	2.00	21.95
Automobile	5	40	1.46	32.44
		40	2.00	21.95
		40	2.00	21.95
		40	1.06	39.29
		40	1.00	43.89
		40	1.24	35.15
Three Wheeler	5	40	1.23	38.62
		40	2.01	20.74
		40	1.08	41.92
		40	1.00	43.89
		40	1.04	42.68
		40	1.00	43.89
Total/Avg.	**24**	**40**	**1.53**	**31.76**

1st Day: Birulia Noon [Link: https://youtu.be/_7FqAamV0Pg]

Vehicle Type	Total Vehicle	Distance (ft)	Speed (ft/sec)	Time (sec)	Speed (km/hr)
Bus	5	40	30.67	1.60	33.65
		40	40.00	1.00	43.89
		40	20.00	2.00	21.94
		40	13.33	3.00	14.63
		40	40.00	1.00	43.89
		40	40.00	1.00	43.89
Truck	5	40	22.91	1.82	24.89
		40	25.00	1.60	27.25
		40	20.00	2.00	21.94
		40	18.80	2.20	19.81
		40	30.76	1.30	33.53
		40	20.00	2.00	21.94
Automobile	5	40	32.00	1.40	35.11
		40	20.00	2.00	21.94
		40	20.00	2.00	21.94
		40	40.00	1.00	43.89
		40	40.00	1.00	43.89
		40	40.00	1.00	43.89
Motorbike	5	40	32.00	1.40	35.11
		40	20.00	2.00	21.94
		40	40.00	1.00	43.89
		40	40.00	1.00	43.89
		40	40.00	1.00	43.89
		40	20.00	2.00	21.94
Three Wheeler	5	40	28.82	1.48	31.50
		40	22.22	1.80	24.22
		40	33.33	1.20	36.33
		40	40.00	1.00	43.89
		40	28.57	1.40	31.14
		40	20.00	2.00	21.94
Total/Avg.	**25**	**40**	**29.37**	**1.55**	**32.16**

1st Day: Birulia After Noon

Vehicle Type	Total Vehicle	Distance (ft)	Time (sec)	Speed (km/hr)
Bus	5	40	1.60	29.47
		40	1.30	33.53
		40	2.00	21.94
		40	1.00	43.89
		40	1.60	27.25
		40	2.10	20.76
Truck	5	40	1.82	24.89
		40	1.60	27.25
		40	2.00	21.94
		40	2.20	19.81
		40	1.30	33.53
		40	2.00	21.94
Automobile	5	40	1.18	33.98
		40	1.00	43.89
		40	1.40	31.14
		40	1.00	43.89
		40	1.00	21.94
		40	1.50	29.06
Motorbike	5	40	1.72	35.24
		40	1.00	54.86
		40	1.90	28.87
		40	2.00	27.43
		40	1.30	42.20
		40	2.40	22.86
Three Wheeler	5	40	1.14	35.02
		40	1.20	36.33
		40	1.00	43.89
		40	1.00	43.89
		40	1.00	21.94
		40	1.50	29.06
Total/Avg.	**25**	**40**	**1.56**	**31.06**

2nd Day NDE Gate Morning [Link: https://youtu.be/2mjSP9Wie54]

Vehicle		Distance (ft)	Speed (ft/sec)	Time	Speed (km/hr)
Bus	5	50	32.25	1.42	41.69
		50	50.00	1.00	54.50
		50	25.00	2.00	27.25
		50	27.77	1.80	30.27
		50	38.46	1.30	41.92
		50	20.00	1.00	54.50
Truck	5	50	33.84	1.58	36.88
		50	38.46	1.30	41.92
		50	25.00	2.00	27.25
		50	26.31	1.90	28.68
		50	29.41	1.70	32.05
		50	50.00	1.00	54.50
Automobile	5	50	42.04	1.26	45.83
		50	50.00	1.00	54.50
		50	45.45	1.10	49.54
		50	26.31	1.90	28.68
		50	50.00	1.00	54.50
		50	38.46	1.30	41.92
Motorbike	5	50	43.03	1.20	46.90
		50	31.25	1.60	34.06
		50	45.45	1.10	49.54
		50	50.00	1.00	54.50
		50	50.00	1.00	54.50
		50	38.46	1.30	41.92
Theree Wheeler	5	50	40.78	1.28	43.76
		50	50.00	1.00	54.50
		50	45.45	1.10	49.54
		50	20.00	2.00	18.34
		50	50.00	1.00	54.50
		50	38.46	1.30	41.92
Total/Avg.	**25**	**50**	**37.91**	**1.36**	**42.86**

2nd Day NDE Gate Noon					
Vehicle		**Distance (ft)**	**Speed (ft/sec)**	**Time**	**Speed (km/hr)**
Bus	5	50	31.30	1.80	34.28
		50	25.00	2.00	27.43
		50	38.46	1.30	42.20
		50	23.80	2.10	25.93
		50	50.00	1.00	54.86
		50	19.23	2.60	20.96
Truck	5	50	19.69	1.72	28.11
		50	1.60	1.60	34.29
		50	26.31	1.30	28.87
		50	23.80	2.10	26.12
		50	25.00	1.00	27.43
		50	21.73	2.60	23.85
Automobile	5	50	31.01	1.74	33.99
		50	50.00	1.00	54.86
		50	25.00	2.00	27.43
		50	31.25	1.60	34.29
		50	23.80	2.10	26.12
		50	25.00	2.00	27.25
Motorbike	5	50	33.84	1.58	37.13
		50	38.46	1.30	42.20
		50	50.00	1.00	54.86
		50	26.31	1.90	28.87
		50	25.00	2.00	27.43
		50	29.41	1.70	32.27
Three Wheeler	5	50	32.09	1.76	35.23
		50	41.66	1.20	45.72
		50	23.80	2.10	26.12
		50	50.00	1.00	54.94
		50	20.00	2.50	21.94
		50	25.00	2.00	27.43
Total/Avg.	**25**	**50**	**29.08**	**1.71**	**33.45**

2nd Day NDE Gate After noon [Link: https://youtu.be/_7FqAamV0Pg]

Vehicle		Distance (ft)	Time	Speed (km/hr)
Bus	5	50	2.01	28.35
		50	2.00	27.43
		50	3.00	18.28
		50	1.80	30.48
		50	2.10	26.12
		50	1.15	39.43
Truck	5	50	1.58	39.26
		50	1.30	42.20
		50	1.10	49.87
		50	1.00	54.86
		50	2.00	27.43
		50	2.50	21.94
Automobile	5	50	1.56	38.51
		50	1.10	49.87
		50	1.60	34.29
		50	1.00	54.86
		50	2.10	26.12
		50	2.00	27.43
Motorbike	5	50	1.72	35.24
		50	1.00	54.86
		50	1.90	28.87
		50	2.00	27.43
		50	1.30	42.20
		50	2.40	22.86
Three Wheeler	5	50	1.76	32.22
		50	1.70	32.27
		50	2.00	27.43
		50	2.20	24.93
		50	1.60	34.29
		50	1.30	42.20
Total/Avg.	**25**	**50**	**1.72**	**35.22**

3nd Day Panchaboti Morning [Link: https://youtu.be/X68cyfKSc1k]

Vehicle		Distance (ft)	Time	Speed (km/hr)
Bus	5	55	1.76	36.33
		55	2.00	30.17
		55	1.60	37.71
		55	1.10	54.86
		55	2.10	28.73
		55	2.00	30.17
Truck	5	55	1.86	33.38
		55	2.10	28.37
		55	1.90	31.76
		55	2.00	30.17
		55	1.30	46.42
		55	2.00	30.17
Automobile	5	55	1.80	34.89
		55	1.80	33.52
		55	1.20	50.29
		55	2.00	30.17
		55	2.10	28.73
		55	1.90	31.76
Motorbike	5	55	1.44	44.05
		55	1.50	40.23
		55	1.00	60.35
		55	1.30	46.42
		55	2.00	30.17
		55	1.40	43.10
Three Wheeler	5	55	1.66	42.04
		55	2.00	30.17
		55	2.40	60.35
		55	1.60	46.42
		55	1.20	30.17
		55	1.10	43.10
Total/Avg.	**25**	**55**	**1.71**	**37.36**

3nd Day Panchaboti Noon [Link: https://youtu.be/_7FqAamV0Pg]

Vehicle		Distance (ft)	Time	Speed (km/hr)
Bus	5	55	2.05	29.66
		55	2.10	28.73
		55	2.00	30.17
		55	1.80	33.52
		55	2.30	26.23
Truck	5	55	1.86	33.73
		55	1.90	31.76
		55	2.10	28.73
		55	1.30	46.42
		55	1.70	35.50
		55	2.30	26.23
Automobile	5	55	1.60	40.35
		55	1.20	50.29
		55	1.60	37.71
		55	1.10	54.86
		55	2.00	30.17
		55	2.10	28.73
Motorbike	5	55	1.60	40.43
		55	1.30	46.42
		55	2.40	25.14
		55	1.50	40.23
		55	1.70	35.50
		55	1.10	54.86
Three Wheeler	5	55	1.76	37.22
		55	2.10	28.73
		55	1.20	50.29
		55	2.40	25.14
		55	1.80	35.52
		55	1.30	46.42
Total/Avg.	**25**	**55**	**1.77**	**36.36**

3nd Day Panchaboti After noon [Link: https://youtu.be/X68cyfKSc1k]

Vehicle		Distance (ft)	Time	Speed (km/hr)
Bus	5	55	2.50	25.14
		55	2.00	30.17
		55	3.00	20.11
		55	2.00	30.17
		55	3.00	20.11
Truck	5	55	1.68	38.39
		55	1.30	46.42
		55	2.10	28.73
		55	2.00	30.17
		55	1.90	31.76
		55	1.10	54.86
Automobile	5	55	1.94	32.44
		55	1.30	46.42
		55	2.40	25.14
		55	2.00	30.17
		55	2.10	28.73
		55	1.90	31.76
Motorbike	5	55	1.82	34.60
		55	1.30	46.42
		55	2.00	30.17
		55	1.50	40.23
		55	2.10	28.73
		55	2.20	27.43
Three Wheeler	5	55	1.92	34.35
		55	1.20	40.23
		55	2.10	50.29
		55	2.00	28.73
		55	2.70	30.17
		55	1.60	22.35
Total/Avg.	**25**	**55**	**1.96**	**33.03**

Table 2: Travel Time

Panchaboti to Berulia (Morining)

Vehicle Transition	Entry time	Exit time	Duration (hr/sec)	Duration (sec)	Length (ft)	Speed (km/hr)
Bus						
1	10:37:31	10:39:37	0:02:06	126	3281	28.57
2	10:37:42	10:39:43	0:02:01	121	3281	29.75
3	10:39:26	10:41:03	0:01:37	97	3281	37.12
4	10:40:41	10:42:25	0:01:44	104	3281	34.62
5	10:41:12	10:42:53	0:01:41	101	3281	35.65
Truck						
1	10:37:41	10:39:50	0:02:09	129	3281	27.91
2	10:37:44	10:39:47	0:02:03	123	3281	29.27
3	10:38:03	10:39:59	0:01:56	116	3281	31.04
4	10:38:17	10:40:01	0:01:44	104	3281	34.62
5	10:38:20	10:40:03	0:01:43	103	3281	34.95
Automobile						
1	10:37:35	10:39:36	0:02:01	121	3281	29.75
2	10:37:38	10:39:41	0:02:03	123	3281	29.27
3	10:38:08	10:39:45	0:01:37	97	3281	37.12
4	10:38:13	10:39:58	0:01:45	105	3281	34.29
5	10:38:15	10:40:00	0:01:45	105	3281	34.29
6						
Motorbike						
1	10:37:50	10:39:41	0:01:51	111	3281	32.43
2	10:38:31	10:40:08	0:01:37	97	3281	37.12
3	10:38:45	10:40:32	0:01:47	107	3281	33.65
4	10:39:29	10:41:12	0:01:43	103	3281	34.95
5	10:40:17	10:42:10	0:01:53	113	3281	31.86
Three Wheeler						
1	10:37:49	10:39:52	0:02:03	123	3281	29.27
2	10:39:05	10:40:48	0:01:43	103	3281	34.95
3	10:40:05	10:42:41	0:02:36	156	3281	23.08
4	10:41:49	10:43:39	0:01:50	110	3281	32.73
5	10:42:15	10:44:17	0:02:02	122	3281	29.51

Panchaboti to Berulia (Noon)

Vehicle Transition	Entry time	Exit time	Duration (hr/sec)	Duration (sec)	Length (ft)	Speed (km/hr)
Bus						
1	1:00:49	1:02:06	0:01:17	77	3281	46.76
2	1:02:36	1:04:07	0:01:31	91	3281	39.56
3	1:03:53	1:04:57	0:01:04	64	3281	56.25
4	1:04:27	1:05:50	0:01:23	83	3281	43.38
Truck						
1	1:01:12	1:02:33	0:01:21	81	3281	44.45
2	1:01:15	1:02:37	0:01:22	82	3281	43.90
3	1:01:50	1:02:55	0:01:05	65	3281	55.39
4	1:01:59	1:03:01	0:01:02	62	3281	58.07
5	1:02:28	1:03:40	0:01:12	72	3281	50.00
Automobile						
1	1:01:00	1:02:15	0:01:15	75	3281	48.00
2	1:01:05	1:02:31	0:01:26	86	3281	41.86
3	1:01:51	1:02:47	0:00:56	56	3281	64.29
4	1:02:01	1:02:59	0:00:58	58	3281	62.07
5	1:02:30	1:03:52	0:01:22	82	3281	43.90
Motorbike						
1	1:01:13	1:02:46	0:01:33	93	3281	38.71
2	1:02:05	1:03:02	0:00:57	57	3281	63.16
3	1:02:49	1:04:25	0:01:36	96	3281	37.50
4	1:03:47	1:05:10	0:01:23	83	3281	43.38
5	1:04:47	1:05:57	0:01:10	70	3281	51.43
Three Wheeler						
1	1:01:02	1:02:21	0:01:19	79	3281	45.57
2	1:02:02	1:04:02	0:02:00	120	3281	30.00
3	1:02:27	1:04:05	0:01:38	98	3281	36.74
4	1:03:43	1:05:17	0:01:34	94	3281	38.30
5	1:02:33	1:04:48	0:02:15	135	3281	26.67

Panchaboti to Berulia (After Noon) [Link: https://youtu.be/NfPQwDwIVjQ]

Vehicle Transition	Entry time	Exit time	Duration (hr/sec)	Duration (sec)	Length (ft)	Speed (km/hr)
Bus						
1	4:00:50	4:02:04	0:01:14	74	3281	48.65
2	4:01:06	4:02:08	0:01:02	62	3281	58.07
3	4:02:23	4:03:23	0:01:00	60	3281	60.00
4	4:03:01	4:04:11	0:01:10	70	3281	51.43
Truck						
1	4:01:02	4:02:07	0:01:05	65	3281	55.39
2	4:01:11	4:02:28	0:01:17	77	3281	46.76
3	4:01:31	4:02:56	0:01:25	85	3281	42.36
4	4:01:35	4:03:02	0:01:27	87	3281	41.38
5	4:02:00	4:04:07	0:02:07	127	3281	28.35
Automobile						
1	4:01:09	4:04:19	0:03:10	190	3281	18.95
2	4:01:18	4:04:30	0:03:12	192	3281	18.75
3	4:01:21	4:04:32	0:03:11	191	3281	18.85
4	4:01:49	4:05:04	0:03:15	195	3281	18.46
5	4:05:05	4:07:10	0:02:05	125	3281	28.80
Motorbike						
1	4:01:17	4:04:27	0:03:10	190	3281	18.95
2	4:01:17	4:04:02	0:02:45	165	3281	21.82
3	4:01:37	4:04:58	0:03:21	201	3281	17.91
4	4:01:46	4:04:56	0:03:10	190	3281	18.95
5	4:03:39	4:06:46	0:03:07	187	3281	19.25
Three Wheeler						
1	4:01:34	4:04:58	0:03:24	204	3281	17.65
2	4:01:37	4:05:02	0:03:25	205	3281	17.56
3	4:02:09	4:05:08	0:02:59	179	3281	20.11
4	4:03:29	4:06:37	0:03:08	188	3281	19.15