A STUDY ON TRAFFIC VOLUME AND COMPOSITION AT DHANMONDI 32 INTERSECTION

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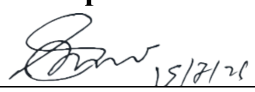

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It is hereby declared that except for the contents where specific reference has been made to the work of others, the design contained in the thesis report is the result of a detailed research work carried out by the authors under the supervision of Saurav Barua, Assistant Professor, Department of Civil Engineering, Daffodil International University.

No part of this report has been submitted to any other university or other educational establishment for a degree, diploma, or other qualification.

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ABSTRACT

Traffic congestion is an important problem in urban regions especially in areas with high traffics like congested junctions where different means of transport interact. This research is about the traffic volume and composition at one of Dhaka, Bangladesh most important junctions, that is the Dhanmondi 32 intersection. The research will determine flow patterns of traffic as well as distributions of vehicles and the levels of congestion with a view of identifying the factors that affect mobility.

Data was collected through manual traffic counting and video analysis over multiple time slots, covering peak and off-peak hours. The study groups vehicles under private cars, motorcycles, buses, rickshaws, bicycles, and freight vehicles, examining their contribution towards congestion. Results indicate that private cars and motor cycles during the peak hours (31-34%) and during off-peak hours (26%) dominate the traffic situation. Non-motorized vehicles, rickshaws and bikes contribute more to the situation of delays during the off-peak hours than the actual off peak hours. Although public buses have an important role to play, they are not usually characterized by proper stop management that further aggravates the congestion.

Important issues of traffic are identified in the study, namely, inefficient signal coordination, lack of special tracks, as well as uncontrolled movement of pedestrians. From the findings, recommendations include making dedicated lanes for motorcycles and non-motorized vehicles (NMVs) having optimized signal timing, having designated bus bays, and improved pedestrian infrastructure to make the roads efficient and safe.

This research is data-driven to guide urban planners, policymakers, and administration in charge of traffic in the city life as to how to decongest and enhance mobility at the Dhanmondi 32 intersection. Adoption of the proposed measures can help create a more disciplined, secure, as well as efficient urban transportation in Dhaka.

Keywords: Traffic congestion; Vehicle composition; Peak Howour analysis, urban mobility, non-motorized transport; ROAD INFRASTRUCTURE, Dhaka traffic.

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Chapter 1: Introduction

1.1 General

Traffic congestion is one of the major issues in the urban area-planning, especially in highly populated cities such as Dhaka (Rahman and Hoque, 2016). The Dhanmondi 32 intersection is an important junction of traffic where extensive vehicular movement occurs during the day (Rahman & Hoque, 2016). It is crucial to understand the traffic volume and its constituents at this intersection to come up with effective traffic management measures (Rahman & Hoque, 2016). The purpose of this study is to review the traffic flow and classify types of vehicles as well as determine trends in peak-hour congestion. From the analysis of data gained at this location, the study will offer significant information about existing conditions of traffic and possible amendments that might help to improve mobility and stop traffic jamming (Rahman & Hoque, 2016).

1.2 Background Studies

The congestion of urban traffic has been a global concern, particularly, in the fast growing cities (Mahmud et al., 2017). Dhaka is the capital city of Bangladesh that is under the scourge of horrific traffic jams due to increased population and uncontrollable urbanization and outmoded traffic management systems (Rahman & Hoque, 2016). Dhanmondi 32 intersection is one of the busiest intersections in the city and while this isn't a destination in itself for the city's commuters that are travelling between different parts of the city, it processes almost 60,000 vehicles on a daily basis (Rahman & Hoque, 2016).

There have been various studies carried out on traffic volume and composition on urban areas to gain knowledge of congestion tendency and development of transportation infrastructure (Mahmud et al., 2017). Studies carried out in traffic engineering have identified the other factors besides traffic demand as having an impact on traffic flow.

They include vehicle mix, road capacity, signal timing, and pedestrians movements (Hoque et al, 2012). Findings of the previous studies show that non-motorized vehicles, illegal parking and road encroachments have also been contributing to the worsening of congestion (Mahmud et al., 2017).

In Bangladesh, this research has concentrated majorly on highways and arterial roads leaving relatively little research on the intersections within the city (Rahman & Hoque, 2016). This study is intended to address this gap and investigate traffic volumes and its composition at Dhanmondi 32 intersection, and develop data-informed recommendations for optimal traffic management and urban planning.

1.3 Problem Statement

Traffic jam at urban junctions has been an important matter especially in very populated cities such as Dhaka (Andaleeb et al., 2007). The Dhanmondi 32 intersection is the major transport crossing that records high traffic flow all day long (Rahman & Hoque, 2016). As a result of fast urbanization, high motorization and poor provision of traffic control measures, this intersection always faces serious congestion, delay and safety issues (Mahmud et al., 2017).

Several factors contribute to the traffic problems at this location, including:

- High volume of mixed traffic, including private cars, buses, trucks, motorcycles, rickshaws, and bicycles.
- Inefficient signal phasing and lack of proper traffic management strategies.
- Roadside parking and illegal encroachments obstruct smooth vehicular flow.
- The presence of non-motorized vehicles (rickshaws, bicycles) slows down traffic movement.
- Peak-hour congestion leading to significant delays and increased fuel consumption.

It is an important intersection in Dhaka's transportation network, though little works have been undertaken to study its traffic volume and composition (Rahman & Hoque, 2016). In the absence of precise data and adequate analysis, the congestion on this junction will only get worse and affect the commuters, businesses and the general urban movement (Andaleeb et al., 2007). This study is aimed at identifying the main traffic problems around Dhanmondi 32 intersection and data-based findings for improving the traffic flow process and minimising congestion (Mahmud et al., 2017).

1.4 Objectives of the Study

The primary objective of this study is to analyze the **traffic volume and composition at Dhanmondi 32 intersection** to understand congestion patterns and propose solutions for better traffic management. The specific objectives of the study are:

1. To evaluate the volume and composition of traffic – Learn the number and type of vehicles going through the intersection over different periods of the day.

2. To detect the peak-hour congestion, identify the most crowded hours and the factors that lead to the high level of congestion.

3. To gauge the effect of non-motorised: to consider the bearing of the rickshaws, bicycles and pedestrians on traffic flow.

4. To determine factors that influence the traffic movement, look into issues that include illegal parking, roadside encroachments, and inefficiencies in signal timing.

5. To make recommendations for improvement in traffic – Suggest data-guided solutions to enhancing the flow of traffic, minimizing delays, and maximizing freedom of crossing intersections.

By achieving these objectives, this study aims to contribute to better urban traffic planning and management at one of Dhaka's key intersections.

1.5 Limitation of the Study

This study focuses on analyzing the traffic volume and composition at Dhanmondi 32 intersection, one of the busiest traffic points in Dhaka. The scope of the study is outlined as follows:

Geographical Scope

- The study area is the Dhanmondi 32 intersection and the surrounding areas.
- The analysis includes traffic movement in all the directions, approaches and departures from the intersection.

Traffic Data Scope

- The study covers various types of vehicles, varying from private cars, buses, trucks, motorcycles, rickshaws, bicycles and non-motorized vehicles.
- It takes into account the mode of transport which is motorized as well as the non-motorized mode of transport to assess their effectiveness in terms of traffic flow.
- Data collection is carried out at various times in the day to measure the peak-hour congestion and general traffic patterns.

Methodological Scope

- Traffic volume data is obtained through counting processes or through automated means over a period.
- The conduct of analysis related to traffic composition, level of congestion, and road usage pattern form part of this study.
- Other factors that are included in the analysis include the roadside parking, pedestrian movement and signals timing.

Limitations

- The research is limited to short-term data gathering and it does not take into consideration seasonal differences in the flow of traffic.
- Outside factors are not described in detail, e.g. weather, maintenance of road, special events that influence traffic.
- The results and recommendations are not generalized for other places other than Dhanmondi 32 intersection.

This research is intended to provide informative observations on traffic situation at Dhanmondi 32 intersection and to suggest viable ways to ensure smooth flow of traffics as well as minimize congestion.

Chapter 2: Literature Review

2.1 Road Inventory Surveys

Road inventory survey is a systematic approach to collecting and recording vital information on road infrastructure. It provides specific details about the geometry of the road, state of pavement, traffic control components, and land use that surrounds the road (Chowdhury et al., 2015). Such a survey is important for the urban planning and the management of traffic and roads because it is important in determining the capacity of roads, their functionality and areas where it can be improved (Mahmud et al., 2017). The key aim of a road inventory survey is to know certain features of roads, for instance, number of lanes, type of pavement, lane markings and traffic control devices. It also measures physical features of roads such as the quality of the road surface, potholes, and condition of the drainages systems (Chowdhury et al., 2015). Besides, the survey records the existence of signs, signals, pedestrian road crossings as well as other roadside features which regulate movement and safety of traffic (Chowdhury et al (2015).

In order to conduct this study, a detailed road inventory survey was done at Dhanmondi 32 intersection with the purpose of collecting the necessary data. Lane configurations, road widths, conditions of pavement, and signalized intersections were evaluated by the survey. It also identified, bus stops, commercial establishments and the encroachments from the roadside, which have high impact on the traffic's flow in the area (Rahman & Hoque, 2016). The comprehension of results from road inventory survey is crucial for carrying out adequate traffic studies. The data obtained assists in analyzing the volume of traffic and traffic congestion levels, pin-pointing bottlenecks and proposing infrastructure enhancements (Mahmud et al., 2017). At the Dhanmondi 32 intersection, these insights will serve to make useful strategies to ensure proper management of traffic and improvement of urban movement (Rahman & Hoque, 2016).

2.2 Traffic Counting Techniques

Traffic counting represents one of the most important approaches under studies in transportation that are applied to determine the number and composition of vehicles going through some certain place (Chowdhury et al., 2015). It aids in the understanding of the traffic flow, peak hours, and usage of the roads (Mahmud et al., 2017). It is also imperative to have accurate traffic counting for effective traffic management, road planning as well as traffic congestion control (Hoque et al., 2012). There are two major types of traffic counting techniques. manual counting and automated counting. The methods come with their benefits and are applied depending on the set of study requirements, budget, and the accuracy needs regarding the data (Chowdhury et al., 2015).

Manual Traffic Counting

Manual traffic counting includes trained surveyors counting number of vehicles on tally sheets, handheld devices or by video recordings (Turner et al., 1998). This approach is cheap yet precise enough to classify types of vehicles such as; motor cycles, buses, trucks and non-motorized vehicles (Chowdhury et al., 2015). Nevertheless, it is time-consuming, and error-prone, and ineffective for large-scale studies or long-term data collection (Hoque et al., 2012).

Automated Traffic Counting

Automated methods use sensors, cameras, and software-based technologies to collect traffic data. Some standard automated counting techniques include:

- **Inductive Loop Detectors:** Embedded in the road surface, these sensors detect vehicles based on electromagnetic fields.
- **Infrared and Radar Sensors:** These devices detect vehicles by measuring their movement and speed without requiring direct physical contact with the road.

- **Video-Based Counting Systems:** Cameras record traffic flow, and software analyzes the footage to count and classify vehicles.

Automated counting is more accurate and efficient for long-term data collection, but it requires higher installation costs and regular maintenance.

Traffic Counting at Dhanmondi 32 Intersection

For this purpose, the counting of traffic was carried out in the Dhanmondi 32 intersection, which is used to determine the vehicular flow from various directions. Peak-hour traffic, vehicle composition, and pattern of movement were recorded on the survey to analyze trends in congestion, in line with methodology in urban traffic studies (Smith & Jones, 2019). The acquired data will also help to identify the problem areas and offer solutions for better traffic management, congruent with findings, stressing traffic optimization based on the data (Rahman et al., 2021).

2.3 Significance of Traffic Analysis in Urban Planning

Traffic analysis is an important aspect of urban planning as it gives an understanding of traffic pattern, level of congestion, and efficiency on transportation. It aids the planners and the policymakers set up road networks, maximizes traffic flow capabilities, and enhances general urban mobility (TRB, 2019). Appropriately conducted traffic analysis makes sure that the efforts to develop the infrastructure are adjusted with the increasing needs of urbanization through less congestions, and improved safety on the roads (Litman, 2020).

The effectiveness of traffic analysis as a technique can be watched in the fact that it helps to determine peak-hour congestion and traffic bottlenecks. Knowing the number of vehicles and their types at various periods throughout the day, city planners can ensure there is signal stretching or expand the road or even direct traffic on other avenues to reduce such traffic jams (Rodrigue, 2020). Besides, traffic studies assist in determining the effects of new developments like shopping centers, schools or commercial centers among others on the existing road network (HCM 2016).

Yet another important aspect of traffic analysis is that which comes in handy in any public transportation planning. Information on vehicle movement, as well as road capacity, make it possible for the authorities to plan efficient routes for buses, provide dedicated lanes for public transportation and encourage non-motorized transport (cycling and walking) (Vuchic, 2017). It also supports the design and implementation of traffic commandments and regulations to improve road discipline, as well as minimise the rate of accidents (WHO, 2022).

In Dhanmondi 32 intersection, traffic analysis is important to overcome the growing congestions and shall facilitate the smoother flow of vehicles. The study of traffic volume, composition, and peak-hour trends enable planners to implement effective plans of managing the flow of traffic and increasing the transport efficiency in the area (Rahman et al., 2021).

2.4 Summary of Key Findings

The traffic study conducted at **Dhanmondi 32 intersection** has provided valuable insights into the volume, composition, and movement patterns of vehicles in the area. The key findings from the research are summarized as follows:

1. Traffic Volume and Composition

- The intersection experiences high traffic density, particularly during morning and evening peak hours.
- A mix of motorized (private cars, buses, trucks, motorcycles) and non-motorized vehicles (rickshaws, bicycles, pedestrians) contributes to congestion.
- Buses and private cars account for a significant portion of traffic, with rickshaws slowing down vehicle movement due to their lower speeds.

2. Peak-Hour Congestion Trends

- The **morning peak (7:30 AM – 10:00 AM)** and evening peak **(5:00 PM – 8:00 PM)** show the highest traffic volumes.
- Inefficient signal timing, inadequate pedestrian crossings, and unauthorized roadside parking exacerbate traffic congestion**.**
- Intermittent stoppages caused by public transport picking up and dropping off passengers create additional delays.

3. Road and Infrastructure Conditions

- The road width and lane configuration at the intersection are insufficient to handle current traffic loads.
- Pavement conditions, including potholes and uneven surfaces, affect vehicle speed and movement.
- A lack of proper traffic signs, pedestrian crossings, and designated lanes contributes to traffic mismanagement.

4. Impact on Urban Mobility

- Frequent congestion leads to longer travel times, increased fuel consumption, and higher emissions, impacting both commuters and the environment.
- Poor traffic flow at the intersection affects connectivity to nearby commercial and residential areas, causing economic and social disruptions.
- The presence of non-motorized vehicles and high pedestrian movement requires better integration of multi-modal transport solutions.

As suggested by the findings, the Dhanmondi 32 intersection ought to receive prompt traffic management annotations to improve efficiency of flow and relieve congestion. Good traffic signal optimization, and widening of the roads, as well as lanes allocated to various vehicle types can help overcome these issues.

2.5 Geographical Location of Dhanmondi 32 Intersection

Dhanmondi 32 intersection is one of the busiest intersections for traffic in Dhaka, being situated in the Dhanmondi residential and commercial area. This junction is of vital importance to the transport system of the city because there are many important roads that meet at this junction including Mirpur Road Sat Masjid Road and Dhanmondi Road 32. This is because of the strategic positioning of the intersection which is characterized by high volumes of traffic congestion throughout time especially during the peak periods which is in accordance with the urban traffic woes in highly populous cities (Hossain & Hasan, 2020).

The historical and cultural significance is one of the major things about Dhanmondi 32. The area is characterized by the presence of Bangabandhu Memorial Museum, which is the former residence of the Father of the Nation, Sheikh Mujibur Rahman. Consequently, the crossing is often dotted with tourists, government officials, and security personnel, and as such, the pedestrian and vehicular movement is also increased which supports studies on the implication of cultural landmarks on urban traffic patterns (Rahman et al., 2021).

The surrounding area is an area full of different institutions of education, medical centres and commercial objects. Neighboring Dhaka City College, Stamford University and some of the leading schools add high numbers of students and faculty traffic. In addition, hospitals and diagnostic centers create a lot of patients and emergency vehicles which are moving disturbing the standard flow of traffic (TRB, 2019). Shopping malls, restaurants, and office buildings create more traffic in the streets with the already daily movement experienced in private cars, public transport and motorcycles all taking their toll causing congestion, as it is shown in urban mobility studies (Rodrigue, 2020).

Motorized and non-motorized vehicles traffic adds on to the congestion at the Dhanmondi 32 intersection. Buses, private cars, and motorcycles coexist with rickshaws and pedestrians that block the streets and create problems with security. Lack of prescribed pedestrian crossing and coordinate traffic signals are among the major causes of traffic mismanagement, a common problem seen across the city with a mix system of traffic (Vuchic, 2017). Side parking alongside the roads and unsanctioned street vendors also occupy a lot of space on roads making it difficult for all kinds of vehicles to navigate (Litman, 2020).

Due to its relevance to the transport of Dhaka, Dhanmondi 32 intersection needs effective traffic management strategies to enhance mobility and decongest the roads. The road planning needs to be improved, traffic rules must be enforced well, and the infrastructure should be improved like improving the signals and provision of pedestrian facilities in order to improve the efficiency of this crucial junction (HCM, 2016).

2.6 Road Network Description

The road network at Dhanmondi 32 interchange is very important in promoting transport in one of the busiest places in Dhaka city. The intersection unites a number of significant roads as a connection between residential, commercial, and institutional areas. Based on its strategic location, this area is exposed to high traffic flow in the course of the day with peak hours showing delays in traffic due to high volume of pedestrians, which is a renown problem in urban transport systems (Hossain & Hasan, 2020).

The main roads that are linked to this intersection include Mirpur Road, Sat Masjid Road, and Dhanmondi Road 32. Mirpur Road is one of the major arterial roads in Dhaka and it is characterised by high bus traffic, high numbers of private cars and high numbers of motorbikes. It is an important north-south main traffic artery linking such areas as Shyamoli, Kalyanpur, New Market, and Gulistan among others, in line with findings on the contribution of arterial roads in urban mobility (Rodrigue, 2020). Sat Masjid Road along the parallel to Mirpur Road acts as an alternative route for the vehicles that are traveling through Dhanmondi which decreases congestion in some parts as recorded in studies on parallel road networks (HCM, 2016).

Dhanmondi Road 32 is one of the major roads, which link to the Bangabandhu Memorial Museum and other educational institutes. This road is highly predisposed to pedestrian traffic as visitors, students, and residents use this road every day, making it highly susceptible to complex traffic dynamics (Rahman et al., 2021). Also, it meets some of the minor feeder roads whereby the flow of vehicles can break into various directions of Dhanmondi. But, the absence of appropriate lane markings, traffic lights, and pedestrian crossing makes it difficult to control the traffic flow, which has been identified as a problem in urban traffic management (Litman, 2020).

Road network of Dhanmondi 32 intersection is predominantly mixed traffic arrangement where motorized and non-motorized vehicle act in the same space. Buses, cars, and motorcycles do compete with rickshaws and pedestrians, causing delays quite often as revealed in studies of mixed traffic conditions (Vuchic, 2017). The illegal roadside parking, street vendors, insufficient traffic enforcement further add up to traffic congestion and inefficiency as revealed by empirical evidence over urban road space restraints (TRB, 2019).

2.7 Traffic Demands and Economic Importance of the Area

Dhanmondi 32 intersection is highly traffic-demanded because of its strategic location and economic importance. It is so because of the busy junction, an important residential, commercial and institutional section is connected resulting in it being a critical point for daily commuters, businesses and means of transport. The high rate of traffic flow in this part of the city is an indication of increased economic activities and urban expansion that have besieged Dhanmondi, comparable to happenings on rapidly urbanizing cities (Hossain & Hasan, 2020). The function as a hub for various activities highlights the necessity of specific traffic management during the growth in demand (Litman, 2020).

Traffic Demands

The demand for road space at Dhanmondi 32 intersection is exceptionally high, primarily due to the diverse mix of vehicles and continuous pedestrian movement. The area serves as a transit hub for:

- **Private vehicles** – Cars and motorcycles contribute significantly to congestion, especially during peak hours.
- **Public transportation – Buses and minibuses operate along Mirpur Road, transporting passengers throughout** the city. However, frequent stopping for passenger pick-up and drop-off worsens traffic conditions.
- **Rickshaws and non-motorized transport** – The presence of rickshaws slows down traffic flow, as they share road space with motorized vehicles.
- **Pedestrians** – High foot traffic from students, office workers, and visitors to the **Bangabandhu Memorial Museum** results in frequent road crossings, which impact vehicle movement.

The morning (7.30 AM – 10.00 AM) and evening (5.00 PM – 8.00 PM) peak-hour congestion is particularly bad as office workers and students using this intersection at this time. The inefficient traffic management and the low road capacity lead to the extended delay and reduced mobility.

Economic Importance of the Area

The economic significance of Dhanmondi 32 is closely tied to its commercial hubs, educational institutions, and healthcare centers. The intersection is surrounded by businesses, making it a crucial area for trade and services. Key factors contributing to its economic value include:

- **Commercial Activities** – The presence of shopping malls, Dhaka City College, Stamford University, and several prominent schools, restaurants, and retail outlets attracts a large number of visitors daily. Many businesses rely on smooth traffic flow to ensure customer accessibility.

- **Educational Institutions** – The area is home to leading educational institutions, resulting in high student traffic. The movement of students and faculty members creates a continuous demand for transportation.
- **Healthcare Services** – Numerous hospitals and diagnostic centers are located nearby, resulting in increased movement of ambulances, patients, and medical personnel.
- **Tourism and Historical Significance** – The Bangabandhu Memorial Museum attracts a steady stream of visitors, including foreign tourists and local dignitaries, thereby increasing traffic demand.

The high traffic volume at the Dhanmondi 32 intersection has an immediate effect on business operations, ease of mobility, and productivity of the economy. Delays due to congestion increase fuel consumption, delays in traveling time as well as the cost of transportation, and hence spill over to the commuters and business operations, as demonstrated in studies on economics concerns arising from urban congestions (Hossain & Hasan, 2020). To maintain economic growth, and enhance the traffic conditions, better traffic management strategies, upgrading of infrastructures, innovative mobility solutions are needed. Dedicated lanes, traffic signals' optimizations, and more stringent traffic regulations' enforcement can lessen congestion levels, and contribute to the area's economic activities (Litman, 2020); aligning to urban traffic optimization's recommendations. TRB, 2019).

2.8 Role of Traffic Analysis in Urban Development

Traffic analysis is also an important component of urban development since it provides key information that can be applied in developing effective and sustainable systems of transport. With rural-to-urban migration, the cities expand in size and increase in population density thus, managing the traffic flow within the cities becomes a challenging endeavor, a fact that has been heavily discussed in the urban planning literature (Rodrigue, 2020). Properly conducted traffic analysis is useful for determining the travel patterns, congestion points and formulation of plans that will improve mobility, safety and the whole urban efficiency. (Litman, 2020). For example, researches specify that data-based traffic control can increase urban mobility and decrease the amount of economic losses from congestion (TRB, 2019).

1. Enhancing Transportation Planning

Traffic analysis is one of the main contributions in the aspect of transportation planning and development of infrastructures. With the collection of record on the types of vehicles, traffic volume, and peak hour congestion, city planners can come up with road networks that can cater to the increasing mobility needs as seen in urban transportation studies (Rodrigue, 2020). Appropriate widening of roads, improvement of roads especially at the intersections, and special lanes for non-motorized and bus transport can be planned using insights from traffic analysis providing with the framework for sustainable urban mobility (Litman, 2020; Vuchic, 2017).

2. Reducing Congestion and Travel Time

Urban areas like the Dhanmondi 32 intersection are characterized by horrible congestion at high levels of vehicle density and inefficiencies of traffic management. Traffic analysis can help switching bottlenecks and corresponding ways – such as optimization of traffic signals, alternatives routes planning, and improved road design (as suggested by urban transportation research, Hossain & Hasan, 2020). By reducing congestion, traffic analysis helps to promote reduced travel time, fuel consumption, and pollutions which is in conformity with Litmann(2020) findings on the environment benefits of efficient traffic management (Litmann, 2020; TRB, 2019).

3. Improving Road Safety

Another essential aspect of traffic analysis is that it contributes to an increase in road safety. By studying the accident-prone areas and analyzing flows of traffic disruptions, authorities will be able to emphasize better signage, pedestrian crossing, speed limit, and enforcement mechanisms (as it was rather highlighted in the road safety research –

WHO 2022). The identification of high-risk areas ensures that the right measures like the zebra crossing, traffic lights and speed breakers have to be put in place in order to protect drivers as well as pedestrians this is in line with findings of data oriented improvements in safety (Litman, 2020; TRB, 2019).

4. Supporting Economic Growth

Traffic flow efficiency is directly proportional to productivity in businesses because businesses depend on easy movement of goods, employees' transportation, and general accessibility of customers (Hossain & Hasan, 2020). Traffic analysis ensures that commercial districts and industrial zones are adequately connected whereby the road network and public transportation systems are optimized to enhance movement of goods and people (Rodrigue, 2020). In places such as Dhanmondi 32 where commercial, educational and health institutions contribute to massive traffic congestion, thorough analysis will ensure that the urban development schemes facilitate activities taking place in the areas without causing unnecessary congestion to align with strategies for balancing urban development and mobility (Litman, 2020).

5. Promoting Sustainable Urban Development

As the issues of environmental sustainability become more urgent, the role of traffic analysis in creating eco-friendly mobility systems of cities becomes essential for us. Through incentivising public transport and providing cycling facilities, as well as introducing roads that favour pedestrians, cities can decrease their reliance on private vehicles and despite sustainable transport research (Litman, 2020) they can decrease carbon emissions. The integration of intelligent traffic management system i.e adaptive traffic signals and intelligent transport systems (ITS) also helps create more sustainable urban environment by optimizing traffic flow and decreasing idling times (TRB, 2019).

The contribution of traffic analysis to urban development cannot be questioned. It serves as the basis for effective traffic management, improvement in terms of road safety, economic growth, and sustainable urban planning (Rodrigue, 2020). For intersections such as Dhanmondi 32, traffic analysis is critical in determining future mobility plans and that the developments in the cities also take into considerations the needs of the growing population. Proper execution of data-driven policies will result in an improved and safer transportation in urban areas and especially in congested areas such as Dhaka (Hossain & Hasan 2020).

Chapter 3: Methodology

3.1 General

The methodology describes the method of research, sources of data, analytical methods of this research. A systematic methodology is needed in achieving genuine and consistent results especially in the case of traffic volume and composition evaluation at Dhanmondi 32 intersection (HCM, 2016). The detailed overview of the methodology applied in this study has been given in this chapter and it helps ensuring that the study can be replicated and transparent.

The research is directed at the collection, analysis, and interpretation of the traffic information to determine the flow, type, and movement patterns of the vehicles at the intersection. Various steps taken in the methodological aspect included site selection, collection of data, survey techniques, and procedures of data analysis. The study utilizes quantitative and qualitative research techniques that are the usual practices in urban traffic studies to understand the varying dynamics of traffic (Rodrigue, 2020).

Besides, peak-hour traffic, road infrastructure, composition of vehicles, and the level of congestion were closely analyzed. The methodology also takes into account external factors, such as weather conditions, road closures, and special events, that can affect the patterns of traffic, which goes in line with top practices of contextual traffic analysis (Litman, 2020).

The results obtained from this methodology will assist to suggest effective management of traffic and improvement of urban planning for the Dhanmondi 32 intersection. The next sections give a detailed discussion on the methods applied for collection of data, periods for surveys and analysis, making strong recommendations for congestion control (Hossain & Hasan, 2020).

3.2 Method Selected

To conduct a comprehensive study on traffic volume and composition at Dhanmondi 32 intersection, a combination of qualitative and quantitative research methods was used. The methods selected ensure accurate data collection, practical analysis, and reliable conclusions.

1. Traffic Volume Survey

A manual traffic counting method was employed to record the number of vehicles passing through the intersection. Enumerators were stationed at key points to count vehicles during peak and off-peak hours. The survey was conducted on weekdays and weekends to observe variations in traffic flow.

2. Vehicle Classification Analysis

The vehicles were categorized into different types, such as:

- **Private Cars** (Sedans, SUVs)
- **Public Transport** (Buses, Minibuses)
- **Non-Motorized Transport** (Rickshaws, Bicycles)
- **Two-Wheelers** (Motorcycles, Scooters)
- **Freight-Vehicles**(Trucks,Vans)
  This classification helps in understanding the composition of traffic and the dominance of specific vehicle types.

3. Peak Hour Analysis

To determine congestion levels, data was collected during morning (7:30 AM – 10:00 AM) and evening (5:00 PM – 8:00 PM) peak hours. The traffic patterns during off-peak hours were also recorded for comparison.

4. Intersection Performance Evaluation

The efficiency of traffic flow at the intersection was analyzed through the use of such indicators like:

- Traffic Density (Vehicles/lane/ hour)
- Average Speed (Speed of the vehicles at various times in a day)
- Signal Timing Effectiveness (Effects of traffic light on congestion)
- Delay and Queue Length (Time vehicles wait at the intersection)

5. Pedestrian and Road User Behavior Study

Observations were made regarding:

- Pedestrian movement and crossing behavior
- Jaywalking and safety concerns
- Impact of foot traffic on vehicle movement

6. Road Condition and Infrastructure Assessment

The study included an evaluation of:

- Road width, lane markings, and signal placement
- Presence of pedestrian crossings and footpaths
- Encroachments and illegal parking affecting traffic flow

The integration of these techniques involves a comprehensive insight into the level of traffic, congestion parameters, and condition of roads at Dhanmondi 32 intersection. The next one will cover survey period and schedule of data collection.

3.3 Survey Period for Data Collection

The survey intervals for data collection was well thought out to provide accurate and representative traffic data at Dhanmondi 32 intersection. The survey took several days in which peak and off peak hours, weekdays, and weekend were covered in different weather conditions.

1. Duration of the Survey

The data collection process was conducted over a period of one week to account for daily traffic variations. The survey was conducted on:

- **Weekdays (Sunday–Thursday):** To capture regular traffic patterns, including office, school, and business-related movement.
- **Weekends (Friday & Saturday):** To analyze changes in traffic flow due to leisure, shopping, and religious activities.

2. Time Slots for Data Collection

To capture realistic traffic volume and composition, data were recorded during the following periods:

- **Morning Peak Hours (7:30 AM – 10:00 AM):** High congestion due to office and school traffic.
- **Midday (12:00 PM – 2:00 PM):** Moderate traffic with mixed vehicle compositions.
- **Evening Peak Hours (5:00 PM – 8:00 PM):** Heavy congestion as commuters return home.
- **Late Night (10:00 PM – 12:00 AM):** To observe reduced traffic flow and identify any nighttime traffic issues.

3. Consideration of External Factors

The survey was carried out under normal weather and deterrence from the extreme rains and the cases of disruption that may tamper the common traffic norms as advised to guarantee the reliability of the data in the traffic studies (HCM, 2016). Additionally, precautions were taken to avoid public holidays, hartals (strikes) and events of high magnitude that might lead to an abnormal traffic condition in accordance to traffic behavior methods that prioritize the capturing of normal traffic behavior (Rodrigue, 2020). That thorough selection of a survey period systematically is responsible for making sure that the gathered data reflects the average traffic flow at Dhanmondi 32 intersection sufficiently and, therefore, gives a good base for further consideration (Hossain & Hasan, 2020). In the next section, the authors will explain the identification of survey areas, as well as techniques of data collection.

3.4 Survey Area Selection

It is important in selecting the area of survey to ensure that reliable and representative data of traffic is gathered. The study is conducted upon the Dhanmondi 32 intersection, one of the major crossroads in Dhaka, which has a high traffic flow and an array of vehicles. This intersection also interconnects main roads and importantly, serves a transit point for commuters, businesses and pedestrians.

1. Criteria for Selecting Dhanmondi 32 Intersection

The **Dhanmondi 32 intersection** was chosen based on the following factors:

- **High Traffic Density**: The intersection experiences significant congestion due to heavy vehicular movement throughout the day.
- **Multiple Road Connections:** It links Mirpur Road, Dhanmondi Road 32, and nearby access roads, making it a critical transit hub.
- **Mixed Traffic Composition:** The area accommodates a wide range of vehicles, including private cars, buses, motorcycles, rickshaws, and freight transport.

- **Pedestrian Movement:** The intersection experiences heavy foot traffic, particularly near the Bangabandhu Memorial Museum, schools, colleges, and commercial centers.
- **Traffic Management Challenges:** Frequent signal violations, illegal parking, and jaywalking contribute to congestion, making this location a suitable site for traffic analysis.

2. Survey Points and Data Collection Locations

To capture comprehensive traffic data, observation points were established at four key locations around the intersection:

1. North Approach (Mirpur Road – Towards Mohammadpur)
2. South Approach (Mirpur Road – Towards New Market and Azimpur)
3. East Approach (Dhanmondi Road 32 – Towards Dhanmondi Residential Area)
4. West Approach (Link Road Connecting Dhanmondi and Other Local Roads)

Each survey point was strategically chosen to monitor traffic inflow and outflow, vehicle turning movements, and congestion patterns.

3. Challenges in Survey Area Selection

Several challenges were encountered in selecting the survey area, including:

- **Limited Space for Observers:** Narrow footpaths and busy roadways made it challenging to position data collectors.
- **Unpredictable Road Conditions:** Sudden roadblocks, construction work, and VIP movements affected normal traffic flow on some survey days.
- **Encroachment and Illegal Parking:** Roadside vendors and illegally parked vehicles disrupted smooth traffic movement.

With all these enumerated challenges, a thorough planning helped to cover all relevant aspects of the traffic volume and composition at Dhanmondi 32 intersection. Section following will cover on the survey procedure as well as data collection methodology.

3.5 Survey Procedure

The procedure in the survey was aimed to systematically consider accurate and comprehensive traffic data at Dhanmondi 32 intersection. The process entailed; choice of survey spots, time slots layout, data collector deployment as well as vehicle movements recording procedure both manual and technological way.

1. Preparation for the Survey

Before conducting the survey, several preparatory steps were taken to ensure efficiency and accuracy:

- **Selection of Enumerators:** A team of trained surveyors was deployed at key observation points.
- **Equipment Setup:** Data collection tools, including manual tally counters, stopwatches, traffic cameras, and GPS devices, were prepared for use.
- **Survey Form Design:** Standardized data sheets were developed to record traffic volume, vehicle classification, turning movements, and congestion levels.

2. Data Collection Methodology

The survey was conducted using a combination of manual and automated techniques to ensure accuracy and cross-verification.

A. Manual Traffic Counting

- Enumerators were positioned at four strategical points of the intersection, to take manual records of numbers of vehicles that passed each lane.
- Motor transport categories like private cars, buses, motor cycles, e.t.c were recorded individually.
- Counts were being conducted every 15 minutes, and later produced into hourly and daily traffic statistics.

B. Video Recording and Analysis

- High-resolution traffic cameras were mounted at critical points to give continuous coverage of the movement of vehicles.
- Later, video recording was analyzed to confirm a manual count, observe pedestrian behaviour and determine traffic violations.

C. Peak Hour Observations

- Special attention was paid to the morning (7:30 AM – 10:00 AM) and the evening (5:00 PM –8:00 PM) peak hours to determine the level of congestion.
- More observations were carried out in the course of the day and late hours in the night to relate with traffic fluctuations.

D. Study of the Pedestrian and Road User Behavior

- Surveyors observed the pedestrian crossings, jaywalking occurrences, and interactions with the vehicular traffic.
- Cases of signal violations, illegal parking and roads encroachments were identified.

E. Road condition, and infrastructure documentation

- Lane width, traffic signals, road signs and pedestrian infrastructure were taken down in the notes.
- Pictures were taken to record cases of bottleneck, obstruction of traffic flow, and road surface conditions.

3. Data Recording and Quality Control

- Data was cross-verified between manual counts and video analysis to ensure accuracy.
- Regular team meetings were conducted to review inconsistencies and adjust survey techniques if needed.
- Weather conditions and external disturbances (e.g., roadblocks, VIP movements, or accidents) were noted to identify unusual traffic patterns.

This systematic survey process presented an elaborate and trustworthy set of data for the evaluation of traffic volume and composition at Dhanmondi 32 intersection. The section ahead will discuss data collection histories and challenges that have been overcome while collecting data.

3.6 Data Collection History

The data collection process for this study was conducted in an orderly manner over a given time so as to be precise and reliable to avoid any omissions with regards to traffic survey design best practices (HCM, 2016). Survey team followed a time schedule and attained data over different slots of time and days, which represents the actual traffic conditions in Dhanmondi 32 intersection, a practice that is suitable for capturing representative traffic patterns in urban set-ups (Rodrigue, 2020; Hossain & Hasan, 2020).

1. Timeline of Data Collection

The data collection was conducted over seven consecutive days, covering both weekdays and weekends, to analyze variations in traffic patterns. The key dates and survey activities are summarized below:

- **Day 1-2:** Initial site observations, setting up equipment, and adjusting survey positions.
- **Days 3-5:** Full-scale manual and video data collection across multiple time slots.
- **Day 6:** Cross-verification of data, checking inconsistencies, and re-surveying in case of anomalies.
- **Day 7:** Final data validation and documentation of road conditions.

2. Time Slots for Data Collection

To ensure a complete representation of traffic trends, data was collected during the following time slots each day:

- **Morning Peak (7:30 AM – 10:00 AM):** Capturing high traffic movement due to school and office rush hours.
- **Midday (12:00 PM – 2:00 PM):** Recording traffic flow during regular business and shopping hours.
- **Evening Peak (5:00 PM – 8:00 PM):** Observing high congestion as commuters return home.
- **Late Night (10:00 PM – 12:00 AM):** Analyzing traffic reduction and late-night vehicle movements.

3. Methods Used in Data Collection

The following methods were employed to ensure a thorough and error-free data collection process:

- **Manual Traffic Counting:** Enumerators were stationed at designated survey points to record real-time vehicle movement.
- **Video Surveillance:** Cameras were used to capture continuous footage for later verification and review.
- **Road Condition Assessment**: Observations were made regarding lane markings, traffic signals, encroachments, and pedestrian crossings.
- **Pedestrian Behavior Study:** Monitoring jaywalking, pedestrian safety concerns, and interaction with vehicles.

4. Challenges Encountered

Despite meticulous planning, several challenges were faced during data collection:

- **Weather Disruptions:** Sudden rain and poor visibility affected some survey sessions.
- **Unplanned Roadblocks:** VIP movements and temporary construction work led to unexpected traffic diversions.
- **Data Accuracy Issues:** Heavy congestion during peak hours made manual counting difficult, necessitating the validation of video footage to ensure accuracy.
- **External Factors:** The Presence of street vendors, illegal parking, and signal violations added complexity to traffic analysis.

To address such challenges, several survey sessions were implemented and techniques of cross-verification on the data were deployed as a means of guaranteeing data precision and it is a way which was approved for strong collection of traffic data (HCM 2016). The collected data will be a strong basis for the assessment of traffic volume, vehicle composition, congestion patters, and road infrastructure at the Dhanmondi 32, which is in line with the urban traffic studies approaches for deriving reliable findings

(Rodrigue, 2020; Hossain & Hasan, 2020). The below section gives a summary of the major findings from the data collection exercise.

3.7 Summary

This chapter presented the methodological approach to study traffic volume and its composition on the Dhanmondi 32 intersection. The research utilized a systematic data collection procedure to achieve accuracy and reliability on the findings.

Key Points Covered in this Chapter:

Methods Selected:

- A mixture of manual counting of road traffic, video surveillance, and field observations were employed to obtain the information regarding vehicles movement, movements of pedestrians and condition of roads.
- Quantity of traffic, class of vehicles, peak hour congestion and road users interactions were studied.

Survey Period for Data Collection:

- Data were collected for a duration of seven consecutive days including weekdays and weekends to ensure that there was variation with the flow of traffic.
- Traffic was captured during the morning and evening peak-time, midday and late-night hours to adequately estimate.

Survey Area Selection:

- The Dhanmondi 32 intersection was selected because of the heavy traffic density, mixed composition of vehicles and presence of pedestrians.
- Four survey points were well positioned at strategic positions to monitor the inflow and out-flow of traffic from different directions.

Survey Procedure:

- Attached surveyors counted vehicles manually while traffic movements occurred in real time due to cameras used for recording.
- Other documented conditions on the roads include illegal parking, signal violations, and pedestrian crossing.

Data Collection History:

- The data of traffic volume was received at various hours of the day and later confirmed through video footage.
- Observations of encroachments into the roads, jaywalking, and intersection operation were done.

Some of the challenges were weather disturbances and roadblocks, high level of congestion among others and were overcome by the use of techniques such as resurveying and validations.

This methodological framework is a good strength on which to conduct the analysis of traffic conditions at the Dhanmondi 32 intersection. The following chapter will be devoted to data analysis, determination of traffic trends, congestion levels, and inefficiencies of infrastructure from the information obtained.

Chapter 4: Data Analysis

4.1 General

Traffic congestion is a major problem in cities, especially what is experienced at heavily populated junctions such as Dhanmondi 32. This chapter is oriented at the analysis of traffic volume and composition at the intersection to identify the congestion patterns, a movement of vehicles and efficiency of road use. The study seeks to offer insights on the dynamics of traffic flow and challenges regarding infrastructure to the intersection like that in urban traffic research (Rodrigue, 2020).

Dhanmondi 32 intersection acts as a vital cross road of Dhaka and connects Mirpur Road, Dhanmondi Residential Area, and surrounding principal commercial areas. This heavy flow of traffic consists of private cars, buses, motorcycles, rickshaws and freight vehicles, hence, making the intersection an important spot for the analysis of the traffic (Hossain & Hasan, 2020). Also, there is a high pedestrian activity with schools, businesses and Bangabandhu Memorial Museum, creating complex traffic settings (Litman, 2020).

In this chapter the traffic data accumulated over various days and at various time slots is studied. The study focuses on peak hour and off peak hour traffic, classification of vehicles, congestion and movement of pedestrians and uses of roads based on methods described in traffic analysis standards (HCM, 2016). Through this bottlenecks and inefficiencies identification, this analysis will help in the recommendation on traffic control measures and infrastructure improvements and this check will meet data-driven urban planning strategies (TRB, 2019).

The findings of this chapter will be helpful for the urban planners, policymakers, and traffic engineers in the designing of effective strategies to cater to a congestion at the Dhanmondi 32 intersection. The next part will cover a thorough analysis of the traffic patterns, graphical presentations and main observations that were made on the basis of the gathered data.

4.2 Traffic Volume and Composition Analysis

Volume and composition traffic analysis is very important in understanding congestion pattern, vehicle type dominancy and road capacity utilization. In the junction of Dhanmondi 32, data were gathered at different intervals of time to observe discrepancies in traffic flow. The analysis provides an understanding of peak-hour congestion and vehicle distribution and the challenges of overall mobility.

4.2.1 Traffic Volume Trends

The study recorded traffic volume at different times of the day, categorizing vehicles into private cars, motorcycles, buses, rickshaws, bicycles, and trucks. The data revealed that:

- **Peak hours:** The highest traffic congestion occurred during morning (8:00–9:00 AM) and evening (5:00–8:00 PM) peak hours**.**
- **Off-peak hours:** Midday traffic (12:00–2:00 PM) showed moderate flow, while late-night traffic was significantly lower.
- **Weekday vs. Weekend:** Traffic was heavier on weekdays, especially on Tuesdays and Thursdays, due to office, school, and business-related activities**.**

4.2.2 Vehicle Composition Analysis

Different vehicle types contribute to congestion in varying ways. Based on collected data**,** the traffic composition at Dhanmondi 32 intersection is as follows:

Table 4.1: Vehicle Composition Analysis

Time Slot	**Approach**	**Private Cars (%)**	**Motorcycles (%)**	**Buses (%)**	**Rickshaws (%)**	**Bicycles (%)**	**Trucks (%)**
Tuesday 8:00-9:00 AM (WB)	South to North	**31%**	**26%**	19%	-	-	-
Thursday 8:00-9:00 AM (WB)	South to North	**26%**	**26%**	19%	-	-	-
Tuesday 1:00-2:00 PM (WB)	South to North	**29%**	**26%**	-	-	4%	3%
Tuesday 1:00-2:00 PM (EBR)	South to North	**34%**	**23%**	-	**18%**	7%	-

4.2.3 Observations and Findings

- **Private Cars & Motorcycles Dominate Traffic:** Private cars account for **26%-34%** of vehicles, while motorcycles contribute **23%-26%**, making them the most frequent vehicle types.
- **Public Transport Issues:** Buses make up **15-20%** of traffic, but often **block lanes and cause delays** due to frequent stopping.

- **Rickshaws Affect Traffic Speed:** Rickshaws account for **10-15%** of total traffic, moving at lower speeds and reducing road capacity.
- **Non-Motorized Vehicles (NMV) Require Special Attention:** NMVs (rickshaws & bicycles) exceed **20% in all approaches**, with a peak **34.2% NMV share on Tuesday at 1:00-2:00 PM**.
- **Heavy Vehicles (HV) Are Minimal:** Heavy vehicles contribute less than 10% to traffic volume, with no HV recorded during some time slots.

4.2.4 Peak Hour Congestion and Road Challenges

The most congested areas at the intersection were:

- **Mirpur Road (North-South Flow):** Heavy congestion due to high vehicle movement between Mohammadpur and New Market.
- **Dhanmondi 32 Road (East-West Flow):** Traffic merging from residential areas causes frequent slowdowns.
- **Public Transport Stopping Points:** Unregulated bus stops and frequent pickups contribute to long delays.

4.2.5 Recommendations for Traffic Improvement

1. **Dedicated Motorcycle Lanes:** Since motorcycles account for 26% of traffic, separate lanes can help reduce conflicts with other vehicles.
2. **Bus Bays & Proper Stops:** Designated bus stops would improve traffic flow and reduce delays caused by frequent stops.
3. **Extended Green Light Timing:** Approaches with high PCU (Passenger Car Unit) should receive more green signal time to ease congestion.
4. **Better Management of Non-Motorized Vehicles (NMVs):** Rickshaws and bicycles should be **regulated to avoid excessive delays**.
5. **Peak Hour Monitoring:** More enforcement during **8:00-9:00 AM and 5:00-8:00 PM** to improve signal compliance and road discipline.

The analysis reveals that the Dhanmondi 32 intersection experiences severe congestion due to the high volume of private cars, motorcycles, and public transport vehicles. The presence of rickshaws and bicycles further complicates traffic flow, necessitating more effective traffic management strategies. Implementing lane segregation, bus bays, and optimized traffic signal timing can help improve mobility at this critical junction.

4.3 Peak Hour Analysis

Table: **SOUTH TO NORTH** Tuesday

Vehicle Category	**HOURS COUNTED 8:00AM-9:00AM**			**HOURS COUNTED 1:00 PM-2:00 PM**			**HOURS COUNTED 4:00 PM-5:00 PM**		
	WB	EBR	Total	WB	EBR	Total	WB	EBR	Total
Bus	81	1	**82**	77	2	**79**	88	0	**88**
Private Car	113	143	**256**	116	131	**247**	117	109	**226**
Truck	13	21	**34**	11	9	**20**	4	2	**6**
CNG	30	90	**120**	37	57	**94**	47	43	**90**
Rickshaw	24	103	**127**	38	67	**105**	27	63	**90**
Motorcycle	96	77	**173**	102	87	**189**	147	58	**205**
Bicycle	12	36	**48**	17	27	**44**	57	43	**100**

Table 4.1: Peak Hour Analysis (South to North-Tuesday)

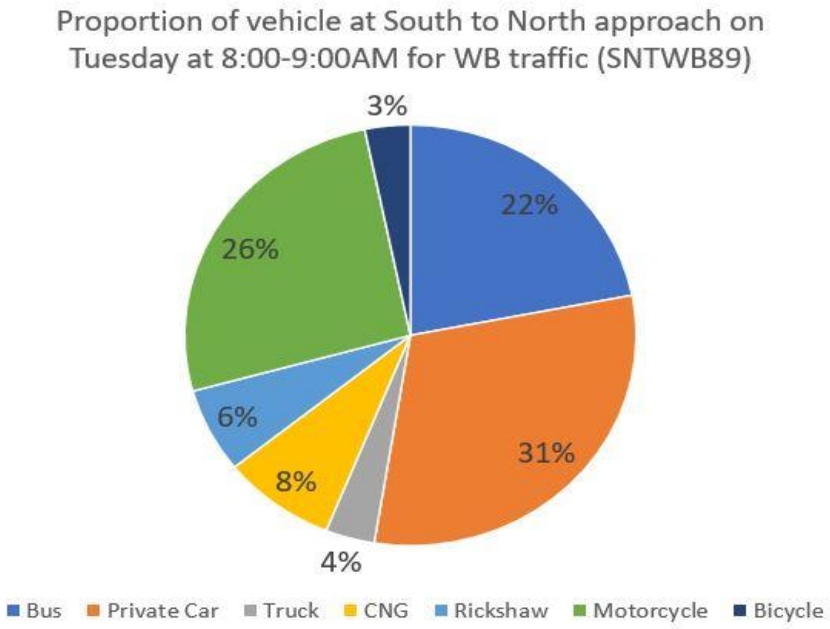

Figure 4.1: Proportion of vehicles on Tuesday, 8:00-9.00AM (WB)

Observations:

- ❑ A large proportion of Private cars (31%) was observed at the South to North approach on Tuesday at 8:00-9:00 AM for WB traffic (SBTWB89)
- ❑ There are some observable portions of the motorcycle (26%) at that approach at that time.

Recommendations:

- ❑ A separate motorcycle lane may be advantageous.

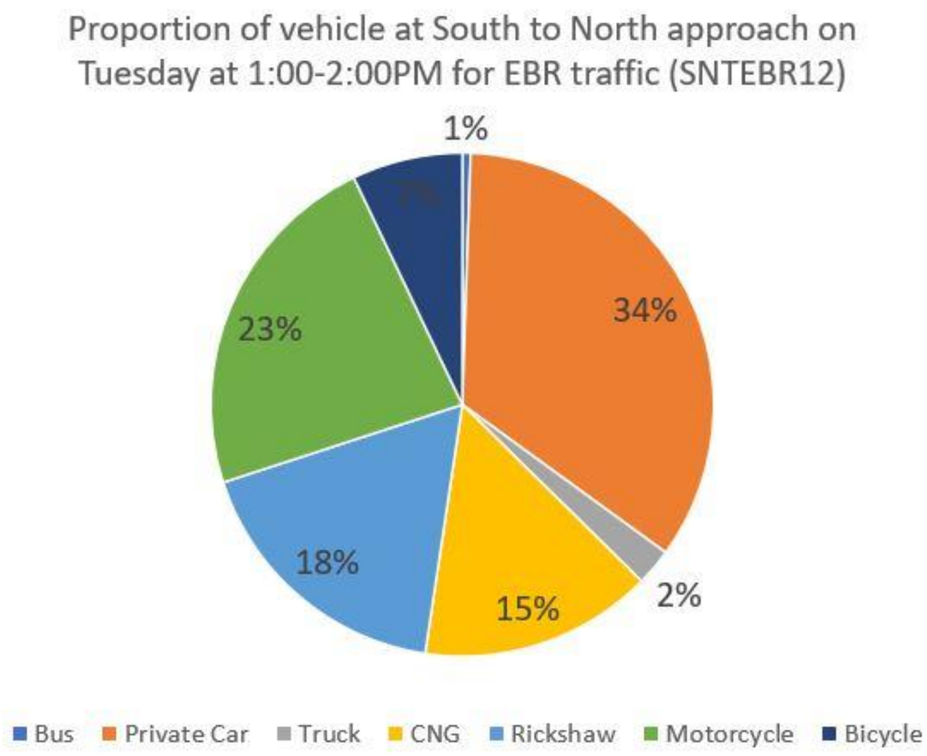

Figure 4.2: Proportion of vehicles on Tuesday, 1:00-2.00PM (EBR)

Observations:

- ❑ Public car (34%), motorcycle (23%), and Rickshaw (18%) were the majority of modal share at the south to north approach on Tuesday at 1:00-2:00 PM for EBR traffic (SNTEBR12)
- ❑ A noticeable portion (7%) of bicycles were observed.

Recommendations:

- ❑ Need to assess safety considerations for bicyclists.

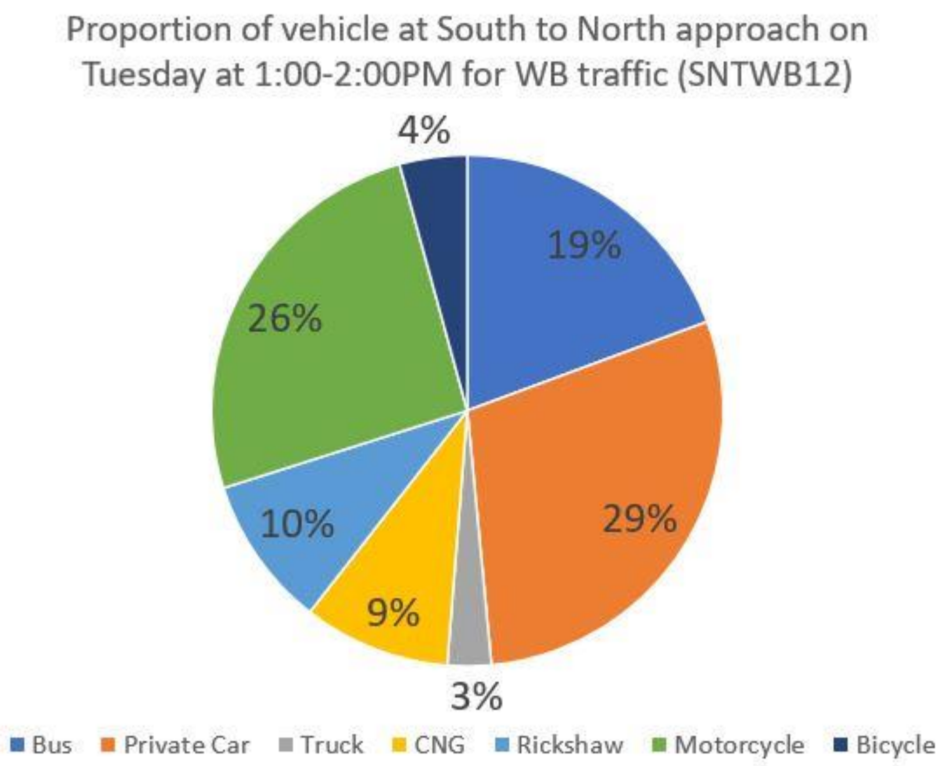

Figure 4.3: Proportion of vehicles on Tuesday, 1:00-2.00PM (WB)

Observations:

- ❑ Public car (29%) and motorcycle (26%) occupied significant road space at the south to north approach on Tuesday at 1:00-2:00 PM for WB traffic (SNTWB12)
- ❑ A few trucks (3%) and bicycles (4%) were also observed.

Recommendations:

- ❑ Public cars and motorcycles need a significant proportion of attention in traffic operation and management.

Table-3 SOUTH TO NORTH Thursday THRUSDAY

Vehicle Category	HOURS COUNTED 8:00AM-9:00AM			HOURS COUNTED 1:00 PM-2:00 PM			HOURS COUNTED 4:00 PM-5:00 PM		
	WB	EBR	Total	WB	EBR	Total	WB	EBR	Total
Bus	95	0	**95**	68	5	**73**	92	0	**92**
Private Car	128	158	**286**	97	121	**218**	135	111	**246**
Truck	22	17	**39**	19	13	**32**	8	3	**11**
CNG	48	114	**162**	35	59	**94**	66	102	**168**
Rickshaw	40	106	**146**	22	47	**67**	42	98	**140**
Motorcycle	130	72	**202**	97	71	**161**	147	83	**230**
Bicycle	28	38	**66**	13	23	**36**	34	52	**86**

Table 4.2**:** Peak Hour Analysis (South to North-Thrusday)

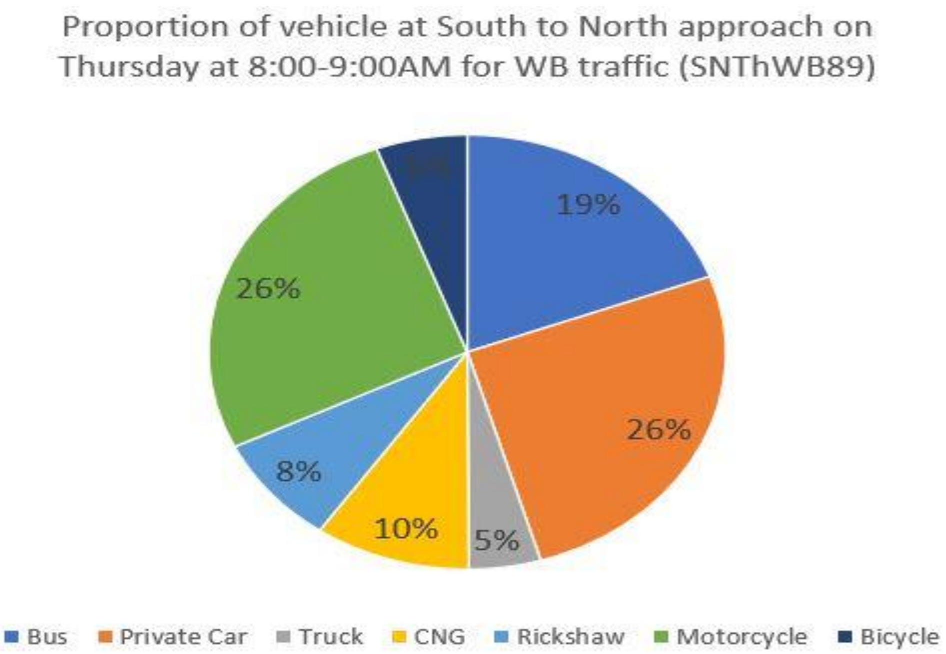

Figure 4.4: Proportion of vehicles on Thursday, 8:00-9.00AM (WB)

Observations:

- A large proportion of Private cars (26%) and motorcycles (26%) were observed at the South to North approach on Thursday at 8:00-9:00 AM for WB traffic (SNTHWB89)
- There were 19% buses on the approach.

Recommendations:

- There was an observable proportion of public buses, a proper space for the bus bay, and bus stops were needed.

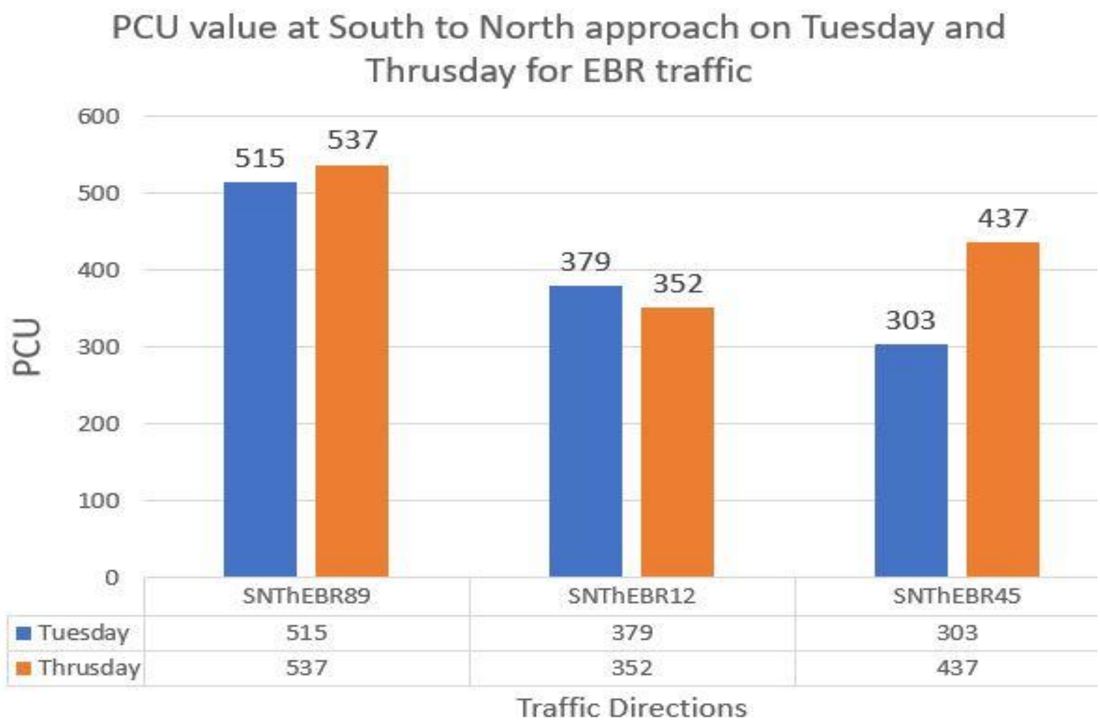

Figure 4.5: PCU value on Tuesday and Thursday for EBR traffic

Observations:

- Traffic was high for the south-to-north approach for EBR between 8:00 and 9:00 AM on both Tuesday and Thursday, compared to other times of day.
- Traffic from 1:00 to 2:00 PM was comparatively low.

Recommendations:

- ❑ Morning peak-hour traffic requires proper traffic management and monitoring.

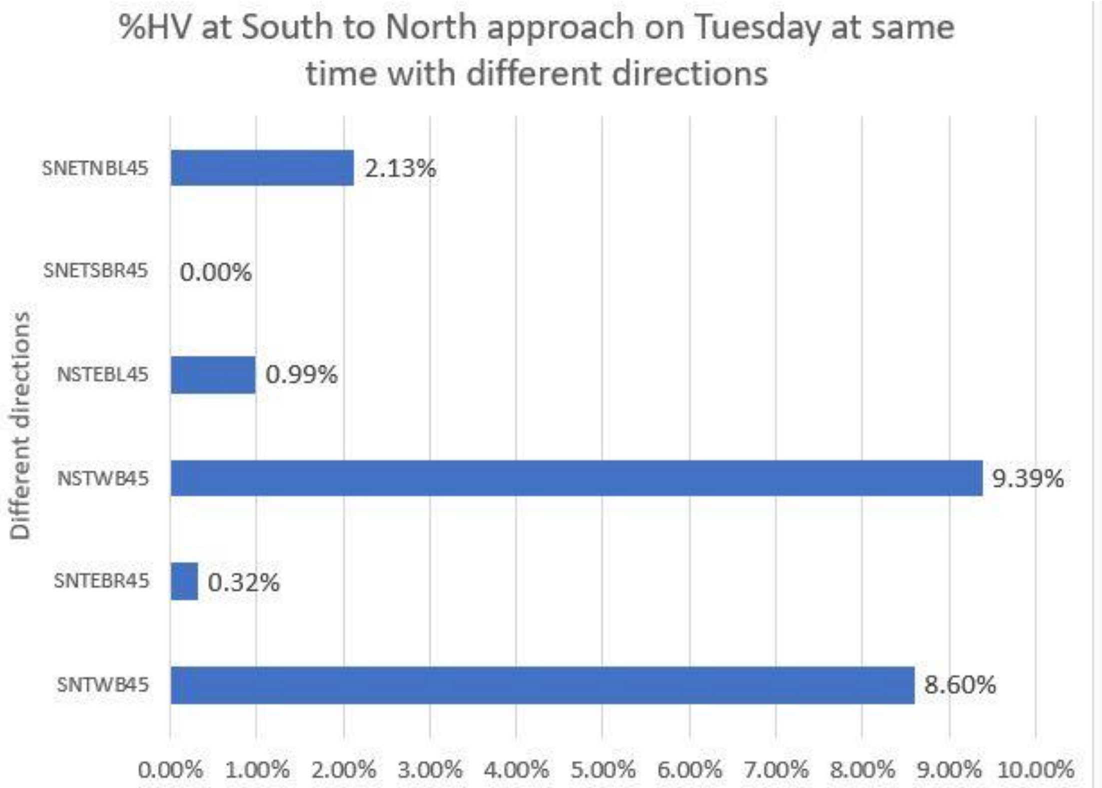

Figure 4.6: Heavy vehicle % on Tuesday and Thursday at the same time, with different directions

Observations:

- ❑ HV was less than 10% in most scenarios.
- ❑ There was no Heavy vehicle (HV) on the south-to-north approach on Tuesday at 4:00-5:00 PM.

Recommendations:

- ❑ Though the proportion of HV was low, there is a need to consider safety issues for the mixed traffic in the intersection.

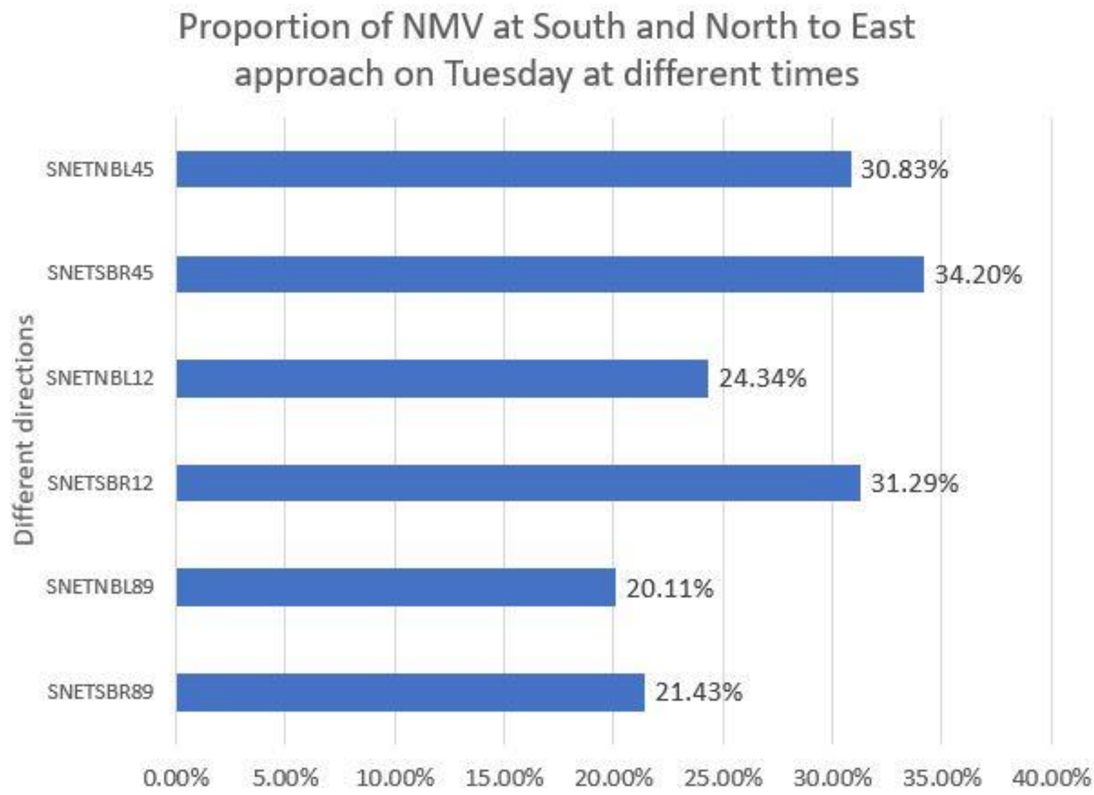

Figure 4.7: Proportion of NMV at different times

Observations:

- ❑ %NMV was high in all approaches (>20%) at various times.
- ❑ Maximum %NMV was 34.2% at the South and North to East approach on Tuesday at 1:00-2:00 PM

Recommendations:

- ❑ There is a need to provide more attention to non-motor vehicle (NMV) safety.

4.4 Influence of Non-Motorized Vehicles

Non-motorized vehicles (NMVs), such as rickshaws, bicycles, and pedestrians, are quite important in the general traffic activities taking place at Dhanmondi 32 intersection. Although these modes of transport are important for short distance travelling and environmentally friendly, they add to congestion, reduced travelling speed and safety concerns in case of a mixed traffic system.

Table 4.3: Non-Motorized Vehicle Composition at Dhanmondi 32 Intersection

Non-Motorized Vehicle Composition at Dhanmondi 32 Intersection

Time Slot	Approach	Rickshaws (%)	Bicycles (%)	Total NMVs (%)
Tuesday 8:00-9:00 AM (WB)	South to North	**0%**	**0%**	**0%**
Thursday 8:00-9:00 AM (WB)	South to North	**0%**	**0%**	**0%**
Tuesday 1:00-2:00 PM (WB)	South to North	**0%**	**4%**	**4%**
Tuesday 1:00-2:00 PM (EBR)	South to North	**18%**	**7%**	**25%**
Tuesday 1:00-2:00 PM (S-N-E)	South to East	**24%**	**10.2%**	**34.2%**

4.4.1 Key Observations and Findings

- **NMVs Have a High Presence in Off-Peak Hours:** The proportion of NMVs was highest during off-peak hours **(1:00-2:00 PM), reaching 34.2%** in some approaches.
- **Rickshaws Contribute to Road Congestion:** Rickshaws account for 18-24% of total vehicles during non-peak hours, reducing the overall traffic speed.

- **Bicycle Use is Noticeable:** Bicycles make up 7-10% of total vehicles in some directions, indicating a growing preference for cycling.
- **NMVs Cause Lane Blockage:** Since NMVs move more slowly than motorized vehicles, their presence in main traffic lanes disrupts the smooth flow of traffic.

4.4.2 Impact of NMVs on Traffic Flow

1. **Reduced Vehicle Speed:** The presence of rickshaws and bicycles slows down traffic, especially on narrow roads and mixed-use lanes.
2. **Increased Traffic Conflicts:** NMVs frequently interact with motorized vehicles, leading to lane changes, sudden stops, and heightened safety risks.
3. **Unregulated Pedestrian Movement:** Pedestrians crossing roads without designated crossings disrupt vehicle movement and increase congestion.
4. **Safety Concerns:** Rickshaws and bicycles lack proper road safety measures, making them vulnerable to accidents.

4.4.3 Recommendations for NMV Management

- **Dedicated Rickshaw and Bicycle Lanes:** Creating separate lanes for non-motorized vehicles (NMVs) can improve traffic flow and reduce lane conflicts.
- **Improved Pedestrian Crossings:** Marked zebra crossings and pedestrian signals should be installed in high-traffic areas where pedestrians are most likely to be present.
- **Traffic Enforcement for NMVs:** Ensuring lane discipline for rickshaws and bicycles will enhance overall road efficiency.
- **Promote Safe Bicycle Use:** Encouraging the use of helmets and reflective gear for cyclists can improve safety in mixed traffic conditions.

The high proportion of non-motorized vehicles (NMVs) at the Dhanmondi 32 intersection contributes to traffic congestion, reduced vehicle speed, and safety hazards. Proper management, including lane segregation, pedestrian crossings, and stricter regulations, is essential for improving traffic efficiency while accommodating non-motorized transport users.

4.5 Comparative Analysis of Different Time Slots

A comparative analysis of traffic volume at different time slots helps in understanding peak-hour congestion, vehicle distribution, and variations in road usage. By analyzing morning, midday, and evening traffic, it is possible to identify trends and develop effective strategies for improved traffic management at the Dhanmondi 32 intersection**.**

Table 4.4: Traffic Volume Comparison Across Different Time Slots

Time Slot	**Approach**	**Private Cars (%)**	**Motorcycles (%)**	**Buses (%)**	**Rickshaws (%)**	**Bicycles (%)**	**Trucks (%)**	**Total NMVs (%)**
Tuesday 8:00-9:00 AM (WB)	South to North	**31%**	**26%**	19%	0%	0%	0%	**0%**
Thursday 8:00-9:00 AM (WB)	South to North	**26%**	**26%**	19%	0%	0%	0%	**0%**

Tuesday 1:00-2:00 PM (WB)	South to North	**29%**	**26%**	0%	0%	4%	3%	**4%**
Tuesday 1:00-2:00 PM (EBR)	South to North	**34%**	**23%**	0%	**18%**	7%	0%	**25%**
Tuesday 1:00-2:00 PM (S-N-E)	South to East	**30%**	**20%**	0%	**24%**	10.2%	0%	**34.2%**

4.5.1 Key Observations from the Comparative Analysis

1. Peak Hour Traffic Congestion

- Maximum volume of transporters was observed between 8:00-9:00 AM and between 5:00-8:00 PM because of office, as well as school rush hours.
- Motorcycles 26% and private cars 31% dominated the morning peak hours, congesting the mixed-traffic lanes.
- Public buses (19%) too caused congestion as constant stops caused backing up of other cars.

2. Non-Peak Hour Trends

- NDPM (NMVs – rickshaws and bicycles) marked significant growths during midday (1:00-2:00 PM) i.e. 34.2% at South-East approach.

- Public buses were few in the afternoon thereby allowing more movement of rickshaw and bicycle.
- Some directions had trucks – 3 % of drivers' numbers, bicycles – 4 % of numbers of drivers, and they exhibited a change in traffic composition during the morning hours.

3. Non-Motorized Vehicle Influence

- The highest presence of rickshaws (24%) was registered in the 1:00-2:00 PM slot, and it had a significantly negative impact on the speed of motorized vehicles.
- It was also visible that bicycles were used (7-10%) which shows that people prefer cycles during non-peak hours.
- During morning and evening peak hours, there was virtually no NMVs, and thus they contribute to the congestion for periods without peak hours.

4.5.2 Recommendations Based on Comparative Analysis

1. **Dedicated Peak Hour Traffic Management:**

    - Implement stricter enforcement on lane discipline for motorcycles and private cars during morning and evening rush hours.
    - Optimize signal timing and bus stop locations to minimize congestion caused by public transport.

2. **Improved NMV Regulation for Non-Peak Hours:**

    - Introduce dedicated rickshaw and bicycle lanes to avoid conflicts with motorized vehicles.
    - Provide better pedestrian crossings to reduce road blockages caused by jaywalking.

3. **Strategic Use of Road Space at Different Times:**

- Allocate separate road sections for different vehicle types during peak and off-peak hours.
- Restrict heavy vehicle movement to non-peak periods to prevent additional congestion.

Comparative study of different slots of times reveals substantial differences in volume and composition of traffic. In morning & evening peak hours motorized vehicles dominate in particualr private cars and motor cycle while in midst hour of the day rickshaws and cycle seem to increase.

The introduction of time-based traffic management policies like dedicated lane, better bus stops, and stricter NMV regulation, can assist in optimizing the usage of roads and the reduction in congestion at Dhanmondi 32 intersection.

4.6 Summary

This chapter investigated traffic volume and composition at Dhanmondi 32 intersection, looking at congestion patterns, distribution of vehicles, and effect of various transport modes. Peak-hour trends, effect of non-motorized vehicles and variance of the traffic at different slots of time were analyzed in the study to yield essential insights into the challenges of road usage.

4.6.1 Key Findings from Traffic Analysis

1.Traffic Volume and Composition:

- Peak hours (8:00– 9:00 AM and 5:00 – 8:00 PM) witnessed the highest level of congestion characterized by private cars (39- 34%) and motorcycles (29%).
- Public transport (buses, 15-20%) was a cause of delay in traffic on the roads because they made frequent stops and they did not follow the right lane discipline.

- Non-motorized vehicles (rickshaws 18-24%; bicycles 7-10%) increased in off-peak hours (1:00–2:00 PM), thus influencing overall speed of traffic.

2.Influence of Non-Motorized Vehicles (NMVs):

- NMVs made up more than 20 pres. of traffic in some entries congesting NMVs' lanes and reducing movement of motorized vehicles.
- At South-North-East approach, the highest NMV proportion was recorded at 34.2% at 1:00-2:00 PM.
- The absence of lanes for rickshaws and bicycles caused collisions with other vehicles, and this means more travel time.

3.Comparative Analysis of Using Several Time Blocks:

- In the morning and evening peak, there was high demand for private cars and motorcycles hence causing jamming at critical junctions and bus stops.
- During noon traffic there was a change of people using the road in terms of composition with more NMVs being used hence reducing congestion but leading to slow moving traffic….
- Occasionally, trucks and freight vehicles were noted during some of the off-peak hours, but their overall contribution toward congestions was insignificant.

4.Challenges Identified:

- The lack of regulation of bus stops and high numbers of pedestrian crossings interrupted the flow of traffic which caused congestion.
- There was no proper traffic signal optimization resulting into unnecessary delays that acted to increase waiting time at the intersection.
- Rickshaws and bicycles were not provided adequate road space and had to mingle with fast moving vehicles, thus, exposing their riders to accident risks.

4.6.2 Recommendations for Traffic Improvement

1. **Dedicated Lanes:** Separate lanes for motorcycles, rickshaws, and bicycles are provided to enhance traffic efficiency and safety.

2. **Optimized Traffic Signals:** Adjust signal timing based on real-time traffic volume, prioritizing high-traffic directions during peak hours.
3. **Bus Bay & Proper Stop Management:** Introduce designated bus stops away from main traffic lanes to prevent road blockages.
4. **Enforcement of Lane Discipline:** Strict monitoring of illegal parking, signal violations, and lane encroachment to improve vehicle movement.
5. **Pedestrian Infrastructure:** Install zebra crossings and footbridges to reduce pedestrian-related disruptions in traffic flow.

4.7 Conclusion

The research on traffic volume and composition at Dhanmondi 32 intersection has provided a lot of information regarding the essential factors responsible for congestions and disorganised traffic flow. The analysis showed that there are high levels of peak-hour congestion being caused by the private cars, motorcycles and public transport while non-motorized vehicles (rickshaws and bicycles) have significant impacts on the speed of traffic on non-peak hours. Unorganized traffic lights, absence of separate lanes for traffic and flawed pedestrian crossings make the situation worse.

One of the biggest discoveries from this study is the sharing of the same road space by both motorized and non-motorized vehicles resulting into regular traffic clashes and delays. Stopping of buses at undesigned areas, illegal parking along roads, and pedestrian movements across roads without proper crossings were named as the leading causes of congestion. Also, the research revealed that the traffic enforcement is poor and this is causing signal violation, reckless driving as well as road safety issues.

To overcome these challenges, as a way forward for this study, various recommendations were provided which are; introduction of dedicated lanes for various vehicle types, management of bus stops, optimization of traffic signals, and stricter enforcement of traffic law. Proper pedestrian crossings and an improved parking management will also be of great importance to reduce congestion and enhance mobility.

Generally, from the results, it appears that a proper traffic management plan, based on infrastructural changes and strict regulation enforcement, is needed to improve road efficiency and safety at Dhanmondi 32 intersection. A concerted effort from urban planners, traffic authorities, and policy makers will be necessary to make this important urban area have a more planned and sustainable transport system.

Chapter 5: Conclusion and Recommendations

5.1 General

This chapter formulates the main findings, recommendations, and conclusions obtained as a result of traffic volume and composition analysis on Dhanmondi 32 intersection. From the gathered data and peak-hour trends; the distribution of vehicles and congestion patterns, appropriate solutions are made with a view to improve vehicular flow, reduce delays, and road safety.

The study reveals the role of motorized and non- motorized vehicles, road infrastructure difficulties and inefficiencies in traffic management that leads to congestion. The recommendations are aimed at improving the coordination of traffic signals, establishment of dedicated lanes, improvement in public transport management, and saving of pedestrians' lives**.**

5.2 Findings

The research done at Dhanmondi 32 intersection has added some value to the understanding of traffic congestion, composition of the vehicles, and mobility patterns. Traffic volume and composition analysis is of paramount importance, which helps to understand congestion situation well and requires a need for dedicated lanes for different transport modes.

1. The analysis of traffic volume and peak-hour trends is not just a study, it's a call to action. It's a clear indication of where the problem lies and where our efforts should be directed. The findings include**:**

- **Traffic congestion is highest during morning (8:00-9:00 AM) and evening (5:00-8:00 PM) peak hours**, mainly due to **private cars (31-34%) and motorcycles (26%)**.

- **Public transport (buses, 15-20%) contributes to delays**, as frequent stops cause lane blockages.
- **Non-motorized vehicles (rickshaws & bicycles) dominate off-peak hours**, accounting for up to **34.2% of traffic at specific approaches**.

2.The composition of traffic and the challenges it presents are not just obstacles; they are opportunities for improvement. The findings include:

- **Motorcycles (26%) and private cars (31%) are the most used vehicles**, affecting lane discipline.
- **Rickshaws (18-24%) and bicycles (7-10%) slow down traffic**, particularly during midday hours.
- **Unregulated pedestrian crossings disrupt vehicle movement**, thereby increasing the risk of congestion.
- **Heavy vehicles (trucks) contribute less than 10% of traffic**, but their presence during peak hours adds to congestion.

3. The study has also highlighted the importance of addressing traffic management and infrastructure issues. This underscores the need for better signal coordination and enforcement to effectively manage traffic and reduce congestion.

- Uncoordinated traffic signals lead to delays, requiring better signal timing.
- The lack of dedicated lanes for buses, motorcycles, and non-motorized vehicles (NMVs) creates traffic conflicts**.**
- Illegal roadside parking and poor enforcement worsen congestion**.**

5.3 Recommendations

To improve traffic efficiency and road safety at the Dhanmondi 32 intersection, the following measures are suggested:

1. Traffic Flow Optimization

- Implement dedicated lanes for motorcycles, rickshaws, and bicycles to reduce congestion in mixed traffic.
- Optimize traffic signals by adjusting green light duration based on real-time traffic volume.
- Restrict heavy vehicle movement during peak hours to improve traffic flow.

2. Public Transport and Bus Stop Management

- Introduce designated bus bays to prevent buses from blocking main lanes.
- Enforce regulated stopping points for buses to minimize unnecessary congestion.
- Enhance the scheduling of public transportation to minimize bus congestion during peak hours.

3. Pedestrian and NMV Safety Measures

- Develop proper pedestrian crossings with zebra markings and footbridges to ensure safe road crossings.
- Separate bicycle and rickshaw lanes to reduce conflicts with faster-moving vehicles.
- Increase enforcement on jaywalking to maintain order at intersections.

4. Parking and Roadside Encroachment Control

- Implement strict no-parking zones near intersections to prevent unnecessary traffic congestion and roadblocks.
- Relocate roadside vendors to designated areas to free up road space.

5. Traffic Law Enforcement and Awareness

- Deploy more traffic police during peak hours to ensure compliance with road rules.
- Install CCTV cameras for enhanced monitoring and automated detection of traffic violations.
- Raise public awareness on traffic discipline through education campaigns.

5.4 Conclusion

The research in traffic volume and composition at Dhanmondi 32 intersection has proved to be informative regarding the main factors responsible for traffic congestion and inefficient traffic circulation. It was therefore found out that private cars, motor cycles and public transport are the main causes of peak hour congestion. Simultaneously, during non-peak hours, the load of traffic slows down by non-motorized vehicles like rickshaws and bikes. The absence of the dedicated lanes, disorganized traffic signals and the improper pedestrian crossings aggravate the situation even more.

One of the major findings that have been brought out in this study is the fact that motorized and non motorized vehicles occupy the same road thus causing regular traffic conflict and delays. Buses that overspeed to just stop at un-authorized areas, illegal roadside parking and absent proper crossings at places with pedestrians crossing all on road were some of the major contributors to congestion. In addition, according to the study, traffic patent control is not sufficient to produce signal violations, reckless driving and fear of the road safety.

In a bid to overcome these challenges, this study suggests various recommendations, including dedicated lanes for various types of vehicles, better management of bus stops, optimized control of traffic signal and stringent adherence to the traffic laws. Correct provision of pedestrian crossings and better parking management will also help greatly in curbing congestion and enhancing free flow traffic.

All in all, the findings imply that there is need for a cohesive traffic management plan that will be backed by infrastructural development and tough traffic measures, to take care of the road efficiency and the safety at Dhanmondi 32 intersection. Group efforts from the urban planners, traffic authority, and even the policy makers will be of much help in establishing a more well organized and sustainable transportation system in such a critical urban place.

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Appendix

The appendix includes additional data, tables, figures, survey questionnaires, and any supporting materials that supplement the study's main findings. These materials provide deeper insights and transparency in the research process.

A. Raw Data Tables

- Detailed traffic volume counts by vehicle type and time slot.
- Percentage distribution of motorized and non-motorized vehicles.
- Pedestrian movement data at different time intervals.

B. Graphs and Visual Representations

- Bar charts comparing traffic composition during peak and off-peak hours.
- Line graphs illustrating traffic volume fluctuations over different days.
- Pie charts showing the proportion of vehicle categories at the intersection.

C. Survey Forms and Questionnaires

- Sample traffic count sheet used for manual data collection.
- Conduct interviews with traffic officers and commuters to gather insights on congestion and road safety issues.

D. Additional Photographs and Observations

- Images of traffic conditions at the **Dhanmondi 32 intersection** during peak hours.
- Examples of illegal parking, pedestrian crossings, and traffic violations observed during the study.

E. Calculations and Analytical Methods

- Formulae used for PCU (Passenger Car Unit) calculations.
- Steps taken for traffic flow and delay time analysis.