A Traffic Volume Study Between Airport Road And House Building Junction In Dhaka City.

Submitted By

JUNEL AHMED

MEHERIN AFRADH

KAILASH CHANDRA DEBNATH

MD. HARUN OR RASHID

FARHANA BOBY

A thesis submitted to the Department of Civil Engineering in partial fulfillment for the degree of Bachelor of Science in Civil Engineering.



Department of Civil Engineering

Sonargaon University

147/I, Green Road, Dhaka-1215, Bangladesh

Section: 12C

Semester: Summer-2021

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Submitted By:

Junel Ahmed : ID No: BCE 1703012117

Kailash Chandra Debnath: ID No: BCE 1703012107

Meherin Afradh : ID No: BCE 1703012115

Md. Harun Or Rashid : ID No: BCE 1703012060

Farhana Boby : ID No: BCE 1703012116

Under the Supervisor

MD.Redowan Rashid

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APPROVAL FOR SUBMISSION

This is to certify that the thesis report in title **"Traffic Volume Study at Airport to House building Junction''** submitted by Kailash Chandra Debnath- Id no: BCE1703012107, Meherin Afradh- Id no: BCE1703012115, Junel Ahmed- Id no: BCE1703012117, Farhana Boby- Id no: BCE1703012116, Harun Or Rasid – Id no: BCE1703012060 to Civil Engineering at Sonargaon University in partial fulfillment of the requirements for the award of Bachelor of Science.

The Thesis is approved as to style and content by:

Supervisor :

Signature……

Md. Redowan Rashid

Lecturer of Civil Engineering

Sonargaon University

External:

Signature ……

Angila Tabassum

Assistant Professor of Civil Engineering

Sonargaon University

DECLARATION

We thereby declare that the research reported in this thesis has been performed by us and this thesis work or any part of it has not been submitted elsewhere for any other purpose except when due reference is made in the text of the thesis.

Summer, 2021

STUDENT NAME	STUDENT ID	SIGNATURE
Junel Ahmed	BCE-1703012117	……
Meherin Afradh	BCE-1703012115	.....
Kailash Chandra Debnath	BCE-1703012107	……..
Md Harun Or Rashid	BCE-1703012060	……...
Farhana Boby	BCE-1703012116	……..

DEDICATED

"The Thesis Book IS Dedicated To Our parents"

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ABSTRACT

Traffic engineering uses engineering methods and techniques to achieve the safe and time efficient movement of people and goods on roadways. The safe and time efficient movement of the people and goods is dependent on Traffic flow, which is directly connected to the traffic characteristics. The three main parameters of a traffic flow are volume, speed and density. In the absence of effective planning and traffic management of the city, the current road infrastructure cannot cater the future needs of the city. Pedestrian and vehicle volumes have increased significantly in the last decade due to the change of the economics of the middle-class families. The current work studies traffic characteristics in the city of Dhaka at one selected priority junction. In this work emphasis was given on traffic volume and the analysis was carried out through primary traffic flow surveys at **House Building to Airport And Airport To House Building junction** in Dhaka city. Traffic flow is studied by manual methods. For better understanding of the present status of traffic flow at the junction, traffic survey is conducted. With the help of the data collection, an attempt had been made to understand the traffic patterns during different time periods. Traffic control at that junction is also dependent on the traffic flow characteristics. Hence the results from the present study are helpful in controlling the traffic at the intersection and also in suggesting some of the remedial measures to improve the traffic safety in the region.

The Hourly PCU of **Airport road to House building** junction is **3897.** House building to airport road Hourly PCU is **4110.**So level of Service (LOS) of this junction remains **"F"**

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ABBREVIATION

ADT= Average Daily Traffic

AADT= Annual Average Daily Traffic

PCU= Passenger Car Unit

PCE= Passenger Car Equivalent

DEF= Daily Expansion Factor

MEF= Monthly Expansion Factor

HEF= Hourly Expansion Factor

LOS= Level of Service

DD= Directional Distribution

DDHV= Directional Design Hour Volume

CHAPTER -1

INTRODUCTION

1.1General:

Traffic volume studies are conducted to determine the number, movements and classifications of roadway vehicles at a given location. These data can help to identify critical flow time periods, determine the influence of large vehicles or pedestrians on vehicular traffic flow, or document traffic volume trends. The length of sampling period depends on the type of count being taken and intended use of the data recorded. Transportation is one of the most burning issues in every territory of the world. Every country is approaching differently according to their needs and solving their transportations problems within their capabilities. In designing buildings, we need to determine loads coming to the structure to calculate reinforcement to be provided for purpose. For planning, designing and operation of transportation system the first and foremost requirement is volume. Volume is simply the number of vehicles passing a section of a roadway. Under the said traffic conditions expressing traffic volume as number of vehicles passing a given section of road per unit time will be inappropriate and some other suitable base needs to be adopted for the purpose. The problem of measuring volume of such heterogeneous traffic has been addressed by converting the different types of vehicles into equivalent passenger cars and expressing the volume in terms of Passenger Car Unit (PCU) per hour. The PCU is the universally adopted unit of measurement of traffic volume, derived by taking the passenger car as the “standard vehicle”. The interaction between moving vehicles in a traffic stream is highly complex and is influenced by a number of roadway and traffic factors. The accurate estimation of the magnitude of vehicular interaction for different roadway and traffic conditions is the prerequisite for better operation and management of roadway facilities in their prevailing conditions.

Few purposes of traffic volume study are given below:

- To establish relative importance of any route or road facility.
- To plan and design the existing and new facilities of traffic operations on the road.
- To make analysis of traffic pattern and trends on the road.

- To decide the priority for improvement and expansion of a road and to allot the funds according.
- To do design of road intersections, planning signal timings and channelization by Turning movement study.
- To plan one-way street and other regulatory measures by volume distribution study.
- To do planning of sidewalks, cross walks and pedestrian signals by pedestrian volume study.
- To do economic studies after estimating the highway user's revenue.

1.2 Objectives of Study:

The present study is undertaken with the following objectives:

- To determine Vehicle Composition.
- To determine Traffic Stream Properties.
- To determine the service flow rate in PCU.
- To determine Directional Distribution of traffic.

1.3 Scope of Traffic Volume Studies:

The traffic volume count study is carried out to get following useful information:

- Planning traffic operation and control of existing facility.
- Magnitudes, classifications and the time and directional split of vehicular flows. Magnitude is represented by volume of traffic. Vehicles are classified into some predefined classes based on vehicle size and capacity.
- To check existing, operating service condition of a roadway section.
- These variations are needed to establish expansion factors for future use. Using expansion AAD

1.3.1. Design purposes:

To do the structural design of pavements and geometrical design of roads by classified traffic volume study. Traffic design is Plan view selected roadway path with stations. Horizontal curves with stations. Intersection design including minimum turning path, channelization, flaring, traffic control devices viz. traffic signs, markings, signals based on approach volume and turning proportions.

1.3.2. Improvement purposes:

- To plan and design the existing and new facilities of traffic operations on the road.
- To decide the priority for improvement and expansion of a road and to allow the funds according.
- To make an analysis of traffic patterns and trends on the road
- To do the planning of sidewalks, crosswalks and pedestrian signals.
- To increase the LOS necessary steps should be taken to prevent the entrance of NMV, stop road side Parking , prevent pedestrian crossing; introduce optimum traffic signal system. To check the need traffic control devices.
- To determine the type of improvement measure, need to be taken.

1.3.3. Planning Purposes:

Accurate information on the amount of traffic on the roads is vital for the planning of both road maintenance and improvement Traffic volume network analysis for:

- Traffic signal control improvement plan by introducing the area.
- Network analysis helps in deciding/planning if there is need for improvement. Expansion in terms of construction missing links, by-pass, alternative road etc.

1.3 .4. Dynamic Traffic Management Purposes:

Dynamic traffic management employs technologies for real-time traffic management: the management of traffic flows, traffic adaptive control to respond to changing conditions in the transportation system while improving the efficiency, safety and travel conditions of the overall transport network.

1.3.5. Other Purposes:

• To make analysis of traffic pattern and trends on the road.

• To do structural design of pavements and geometrically design of roads by classified traffic volume study.

• Estimation of highway usage.

• Economic feasibility evaluation.

• Computation of accident rates- accidents/100m vehicle-miles.

• To establish relative importance of any route or road facility.

CHAPTER -2

REVIEW OF LITERATURE

2.1General:

Traffic volume studies are conducted to determine the number, movements, and classifications of roadway vehicles at a given location. These data can help identify critical flow time periods, determine the influence of large vehicles or pedestrians on vehicular traffic flow, or document traffic volume trends. The traffic engineer must acquire general knowledge of traffic volume characteristics in order to measure and understand the magnitude, composition and time and route distribution of volume for each area under his jurisdiction.

2.2Traffic Survey:

Traffic surveys are required to transportation engineers for: -

- Planning and designing traffic facilities.
- Determining the need for traffic control devices.
- Studying the effectiveness of introduced schemes.
- Diagnosing given situations and finding appropriate solutions.
- Forecasting the effects of projected strategies.
- Calibrating and validating traffic models etc.

2.3 Main purposes of traffic survey:

Traffic surveys aim to capture data that accurately reflects the real-world traffic situation in the area. It may be counting the number of vehicles using a road or collecting journey time information for example, but there are many other types of data that traffic surveys collect. traffic monitoring, traffic control and management, traffic enforcement, traffic forecasting, model calibration and validating etc.

2.4 Parts of traffic studies:

The various traffic studies generally carry out are:

Traffic Volume Study

- Speed Study
- Origin and Destination study
- Traffic Flow Characteristics
- Traffic capacity study
- Parking study
- Accident Studies

2.5 Traffic Volume Study:

Traffic Volume Study is defined as the survey of number of vehicles and pedestrians crossing section of road per unit during any selected period

• Establish relative importance of any road.

• Structural design of roads.

• Planning and design of new streets.

• Design of intersections and other control devices

• Planning, design and regulation of traffic.

• Establish properties and schedules for traffic improvements.

2.6 Definitions:

2.6.1. Volume/flow:

We define flow rate as the number of vehicles passing a point in a given time period usually expressed as an hourly flow rate. This means that you counted 250 vehicles during a 60-minute interval and expressed the flow rate as an hourly rate.

2.6.2. Rate of flow:

The equivalent hourly rate at which vehicles pass over a given point or section of a lane or roadway during a time interval less than 1 hr.

2.6.3. Average Daily Traffic (ADT):

ADT is average daily traffic is average 24-hour traffic volume counted on the roadway (two way) over a given time period (greater than one day but less than one year) divided by the number of days in that time period.

2.6.4. Annual Average Daily Traffic (AADT):

Annual average daily traffic (AADT) is the total volume of vehicle traffic on a highway or road for a year divided by 365 day.

2.6.5 Directional Distribution:

Directional distribution refers to the percentage of traffic flow in one direction during a particular time of day. This factor is particularly important in the case of commuter roads, where maximum flow occurs in one direction in the morning and the other in the evening.

2.6.6 Passenger Car Unit (PCU):

Passenger Car Unit (PCU) is used to express various types and characteristics vehicles to a common type usually the passenger car. One car is considered to one unit.

2.7 Previous Traffic Volume Studies:

Jie Zhang, et. al. 2021 has been investigating the impact of COVID-19 on the number of people involved in crashes accounting for the intensity of different control measures using Negative Binomial (NB) method. Based on a comprehensive dataset of people involved in crashes aggregated in New York City during January 1, 2020 to May 24, 2020, people involved in crashes with respect to travel behavior, traffic characteristics and socio-demographic characteristics are found. The results show that the average person miles traveled on the main traffic mode per person per day, percentage of work trip have positive effect on person involved in crashes. On the contrary, unemployment rate and inflation rate have negative effects on person involved in crashes. Interestingly, different level of control policies during COVID-19 outbreak are closely associated with safety awareness, driving and travel behavior, and thus has an indirect influence on the frequency of crashes. Comparing to other three control policies including emergence declare, limits on mass gatherings, and ban on all nonessential gathering, the negative relationship between stay-at-home policy implemented in New York City from March 20, 2020 and the number of people involved crashes is found in our study.

According to Scott A. Parr. August 2020, the COVID-19 pandemic resulted in significant social and economic impacts throughout the world. In addition to the health consequences, the impacts on travel behavior have also been sudden and wide ranging. This study describes the drastic changes in human behavior using the analysis of highway volume data as a representation of personal activity and interaction. Same-day traffic volumes for 2019 and 2020 across Florida were analyzed to identify spatial and temporal changes in behavior resulting from the disease or fear of it and statewide directives to limit person-to-person interaction. Compared to similar days in 2019, overall statewide traffic volume dropped by 47.5%. Although decreases were evident across the state, there were also differences between rural and urban areas and between highways and arterials both in terms of the timing and extent. The data and analyses help to demonstrate the early impacts of the pandemic and may be useful for operational and strategic planning of recovery efforts and for dealing with future pandemics.

Corona virus disease 2019 (COVID-19) has impacted and is still disturbing all sectors across the world, including transportation. Due to the pandemic, people around the world were forced to quarantine and tally work, and vehicle circulation only occurred when strictly necessary. In fact, the analysis of road traffic data collected during the current pandemic crisis depicts striking effects of the pandemic on the transportation sector, that is, city movement registered record low values.

Due to the pandemic, people around the world were forced to quarantine and tally work, and vehicle circulation only occurred when strictly necessary. In fact, the analysis of road traffic data collected during the current pandemic crisis depicts striking effects of the pandemic on the transportation sector, that is, city movement registered record low values. The most

congested cities registered an average 5-7% city movement during their respective most critical month of the lockdown.

The current global health disaster serves as an opportunity to evaluate which aspects of modern life are essential, and which are needed to change or improve so that we can look to achieve more sustainable societies and improve our quality of life. The pandemic showed how today the transportation sector faces several new challenges, namely: (1) public transportation needs to have a limit regarding the number of users in order to accomplish social distancing; (2) the use of private vehicles circulating daily tends to increase; and (3) tally working decreases the need to commute and the use of public transportation and private vehicles.

Italy's monthly traffic volume during the morning rush hour was 30 percent below the previous year's level in December 2020. Traffic volume had decreased significantly in March and April, when Italy started ordering people to stay home to limit the spread of the corona virus pandemic.

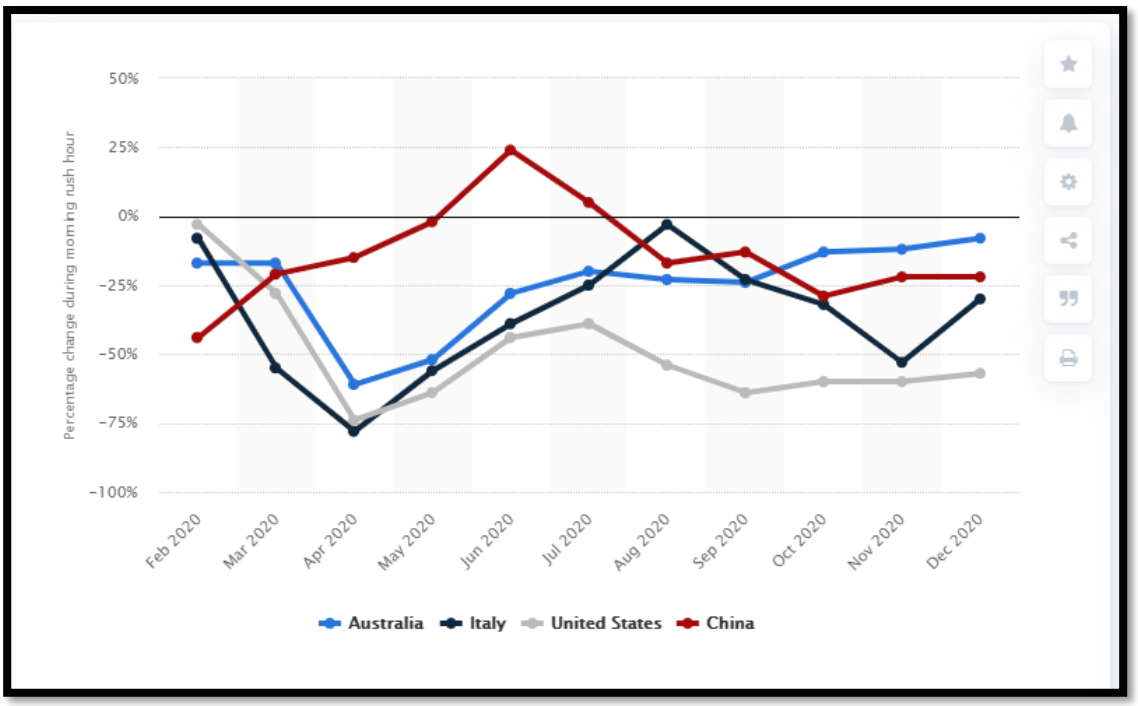


Fig 2.0: Traffic reduction in selected countries amid corona virus crisis 2020 (Wagner, Jun 4, 2021)

COVID-19 Traffic Volume Trends

https://www.ite.org/about-ite/covid-19-resources/covid-19-traffic-volume-trends/

Calgary, Alberta, Canada

Dates of Counts: March 2 – May 31, 2020

Volume Trend (approximate): Weekday segment volumes reduced 54%.

Link: City of Calgary COVID-19 Travel Trends; Mobility Trends in May 2020

Description: A multi-modal review of travel trends in Calgary due to COVID-19. Transit ridership, taxi/ridesharing trips, and passenger car volumes have decreased. Heavy Truck volume has remained consistent with pre-pandemic conditions. Pedestrians and Bikes continue to use the pathway system for recreation. Additional link added to show data through May 31, 2020 for City of Calgary. To provide some context, some business in

Calgary started re-opening the second week of May, and restaurants and hair saloon were able to open up May 25. We are now seeing increases for all modes of travel and slight increases in congestion / decreases in speed during the rush hours.

Los Angeles/Ventura Counties, CA

Dates of Counts: December 1, 2019 – March 31, 2020

Volume Trend (approximate): Total VMT reduced by 30 to 40%

Link: VMT Count Summary

Description: These are the daily VMT trends for last 4 months courtesy of CaltransPeMS. In the last two weeks of March, since "shelter in place" orders were issued March 16, 2020, there has been about a 30% decrease in weekday VMT on freeways in the San Francisco Bay Area and Los Angeles County. Weekend VMT on urban freeways has dropped about 40%. After the initial large drop in the first 48 hours after the orders took effect, there has been continuing, but moderate decreases in VMT. Delays in both the Bay Area and Los Angeles have dropped roughly 80%.

San Francisco Bay Area, CA

Dates of Counts: December 1, 2019 – March 31, 2020

Volume Trend (approximate): Total VMT reduced by 30 to 40%

Link: VMT Count Summary

Description: *These are the daily VMT trends for last 4 months courtesy of Caltrans PeMS. In the last two weeks of March, since "shelter in place" orders were issued March 16, 2020, there has been about a 30% decrease in weekday VMT on freeways in the San Francisco Bay Area and Los Angeles County. Weekend VMT on urban freeways has dropped about 40%. After the initial large drop in the first 48 hours after the orders took effect, there has been continuing, but moderate decreases in VMT.*

Delays in both the Bay Area and Los Angeles have dropped roughly 80%.

Fort Collins, CO

Dates of Counts: ***March 1 – April 7, 2020***

Volume Trend (approximate): Volume reductions from 45% to 55%

Link: Volume Count Summary

Description: In Fort Collins, aggregated counts from system detectors located around the City are presented relative to when the various State orders were put in place. Travel reductions of 45% - 55% are being demonstrated under "stay at home" orders. Context was also provided for the type of traffic volumes relative to other typical days. Christmas Day traffic represents a 66% reduction in travel compared to a typical weekday here.

Loveland, CO

Dates of Counts: March 10 – April 5, 2019 and March 10 – April 5, 2020
Volume Trend (approximate): Percentages not noted.

Link: Count Summary

Description: Compared 2019 vs. 2020 volumes in three locations. Volumes have stabilized and it doesn't appear that volumes have started to tick back up. All of the patterns appear to be holding, just at a lower level than before.

Florida State

Dates of Counts: March 10 – April 7, 2020
Volume Trend (approximate): State traffic volumes reduced 30 to 50%
Link: https://www.fdot.gov/statistics/trafficdata/default.shtm

Description: Florida Department of Transportation has developed a dashboard on traffic volume (and truck) variations related to the COVID-19 restrictions and also provided a summary report.

Cape Corel, FL

Dates of Counts: Feb 2 – April 4, 2019 and Feb 2, 2020 – April 4 2020
Volume Trend (approximate): Total volume reductions up to 60%
Link: Count Summary

Description: Compared day-to-day volumes from last year to this year at a few count stations.

Manatee County, FL

Date of Counts: February 10 to April 16, 2020 (compared to same time period in 2019)
Volume Trend (approximate): 30% to 40% reduction in volume compared to 2019
Link: File 1 and File 2

Description: The first file provides a comparison of the regular weekday traffic from 2019 to 2020. The second compares weekly change in traffic before and after the declaration of local curfew (during the curfew hours).

Lake County, IL

Dates of Counts: February 25 – April 8, 2020
Volume Trend (approximate): Total volumes are down 37% - 48%

Link: Traffic volumes Feb 25-27, 2020 & March 3-5, 2020 (Pre-COVID-19); March 18-19, 2020 & March 24-25, 2020 March 31-April 1, 2020; April 7-8, 2020, April 14-15, 2020 & April 21-22

Description: See executive summary on each count summary for a week by week description. Each description also has a statement on how the week is trending.

Iowa State

Dates of Counts: March 13 – April 14, 2020
Volume Trend (approximate): State traffic volumes reduced approximately 40%

Link: https://iowadot.gov/maps/Data/AUTOMATIC-TRAFFIC-RECORDER-REPORTS

Description: This report contains traffic data collected from over 120 Continuous Count Sites in Iowa State that report how traffic trends have changed since Friday March 13, 2020. The data is being collected daily and compared to the same time period in 2019. They also show traffic truck/freight traffic demonstrating a slight increase, but trending back to normal.

Overland Park, KS

Dates of Counts: March 1 – April 19, 2020
Volume Trend (approximate): Local Road Volume reductions up to 65%

Link: Volume Count Summer

Description: Traffic volume has remained steady between March 25th and April 19th at approximately 50-60% below normal.

Amherst, MA

Dates of Counts: Pre-Covid, 4/15/17; Covid, 3/24/20, 4:30-5:30 PM weekday turning movements
Volume Trend (approximate): Volumes 38.4% of Pre-COVID-19 volumes

Link: Volume Count Summary

Description: Governor issued an order to close non-essential businesses the prior day, 3/23/20. The intersection is proximate to two grocery stores (which were open) and is a major access route to UMASS Amherst (which had sent students home).

Oregon State

Dates of Counts: March 5 – April 7, 2020
Volume Trend (approximate): Not provided.

Link: Moving Average Volumes

Description: 7-day moving average of detector actuations, averaged over 170 traffic signals across Oregon.

Portland, OR

Dates of Counts: December 30, 2019 – March 5, 2020
Volume Trend (approximate): Volume reductions up to 50%

Link: Volume Count Summary

Description: Portland's data is from system detectors at this point and we're using this opportunity to invest more time in the Automated Traffic Signal Performance Measures (ATSPM) system for the City. Portland has finally seen a leveling off of weekday data, so perhaps all of the Stay Home messages have done all they can and we're down to just "essential" traffic.

State College, PA

Dates of Counts: February 10 – April 9, 2020
Volume Trend (approximate): Collector traffic volume reduced approximately 60%

Link: Traffic Volumes on Select Collector

Description: Analysis of 60 days of traffic volumes on an urban collector in State College, PA.

Chattanooga, TN

Dates of Counts: February 18 – April 2, 2020
Volume Trend (approximate): Intersection volume reductions from 10% to 45%

Link: Average 24-Hour Intersection Volume per Week

Description: The City of Chattanooga's Department of Transportation has been Trucking the weekly data at 12 specific locations in the city. The first 8 represent downtown core and the remaining 4 are a representation of other key locations in town.

Salt Lake City, UT

Dates of Counts: Feb 18 – March 5, 2020
Volume Trend (approximate): Intersection volumes reduced by up to 50% to 75% of normal

Link: Intersection Count Summary

Description: Graph includes data from Tues-Thurs using raw data from ATSPMs. On the right side of the graph in the spreadsheet, there is a Truck of a timeline of events (e.g. when the governor signed an emergency declaration; when schools shut down; earthquake; county stay home order, etc). Over the last few weeks, intersection volumes are about 50% to 75% of normal. Here is s a link intersection

data https://docs.google.com/spreadsheets/d/1JSDm902zNYIJG446dscO43noi3UDQai0oAu0WUFmMI/edit?usp=sharing and freeway.

CHAPTER-3

Methodology

3.1General:

Traffic volume studies are conducted to determine the number, movements, and classifications of roadway vehicles at a given location. To study traffic volume, we need data of the vehicle numbers that pass a certain intersection or a section at any point of the survey location. Manual counting method is the handiest and an economical way to survey vehicle numbers. Basic thing to keep in mind that the time interval between which vehicles to be counted. Vehicles can be counted for any duration. Duration of count depends on the objective of data collection. For example, an intersection count may be conducted during the peak flow period. If so, manual count with 60-minute intervals could be used to obtain the traffic volume data. Counting system varies for counting types and purposes. In this chapter we briefly focus on various traffic volume counting method on the basis of anticipated use and methodology.

Survey Zone:



Fig 3.1: Survey Road

3.2*Methods* for Volume Survey:

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

1. Manual Counting Method.
2. Automatic counting method.

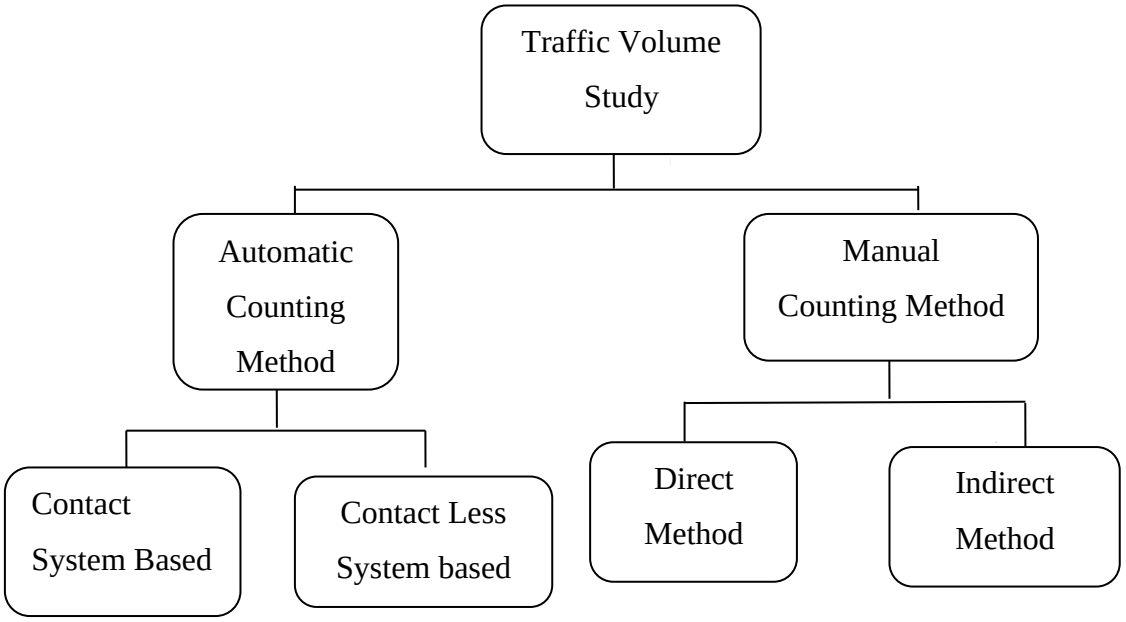


Fig 3.2 Flow Chart of various methods of traffic volume studies

3.3Manual Counting Method:

3.3.1. Direct Method:

Data is counted by using hand tally and manual counters/enumerators.

Advantages: It is easier. Data can be used immediately after collection.

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

3.3.2. Indirect Method:

In this method, video camera is mounted to record the traffic condition of road. Traffic volumes can be counted by viewing videotapes recorded with a camera at a collection site.

Advantages: In addition to the traffic volume, several traffic parameters are available from the recorded film. Data can be cross checked and quality can be ensured. This method is applicable if the volume is high.

Disadvantages: High accuracy required for an observer in classifying the elements of the job because it will affect the calculation result.

3.4. Automatic Counting Method:

Automatic Traffic Counting is capable of counting vehicles according to their class with help of different non-intrusive technologies such as video / photographic method based, infrared sensors, Pneumatic tubes etc. In this method, vehicles are counted automatically without any human involvement. There are two techniques of automatic counting:

- Contact system based on pneumatic road tubes, mechanical, magnetic or electric contact devices.

- Contactless system based on Ultra sound/infrared radar, micro wave, CCTV/video image processing method etc.

Advantages: The automatic count method is suitable for long duration or continuous count. It is used as permanent counting station. The automatic count method provides a mean for gathering 13 large amounts of traffic data. Automatic counts are usually taken in 1- hour intervals for each 24 -hour period.

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

3.5 Methodology of Reconnaissance Survey:

We have adapted Manual Method. In this method, data is collected using a Data Sheet. We just visited the Airport to house building Road and selected the two individual points where vehicles count had to be taken. We visited the spot of study and divided the whole road

length into two equal sections. And thus, we have Selected the reference points where we collected volume data. And on the day of operation we visited Directly to the spot and collected volume data. On each point data was collected for 60 minutes in both directions.







Fig 3.3: Pictures of the road while counting vehicles

3.6 Site Details and Other Information:

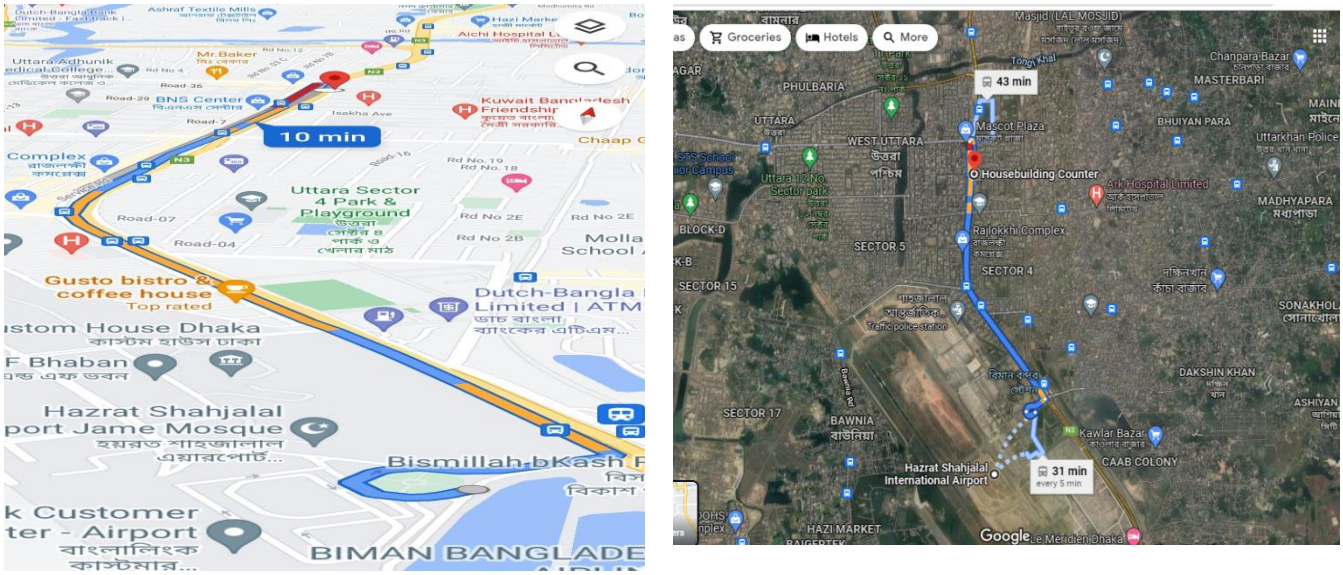


Fig 3.4 Map of the study zone

Location: Location of the traffic volume study was selected to be from Airport to House Building. Vehicles from Airport to House Building & House Building to airport road were counted. Two points were selected which are indicated in the map. We stood by the side of the road and different vehicles were counted by different persons.

Date: Data for volume study was collected on 14th August 2021 to 20th August 2021. .

Time: Time of data collection for volume study for each point was 60 minutes. Data was collected in the two points from 4.30 PM to 5.30 PM.

Weather Condition: It was a Hot & Sunny day.

Observation: Classified Vehicle Counts.

Method: Indirect Manual Counting Method.

Duration: 60 minutes (Short Count).

Equipment: Camera Stop watch, Tally sheet, Pen, etc.

CHAPTER -4

RESULT AND DISCUSSION

Traffic Volume Count :

Day-1

Site & Location : House Building to Airport

Date : 14.04.2021

Time : 4:30Pm- 5:30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table - 4.1

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	74	45	185	16	112	33	6	27
10-20	68	56	109	19	121	37	7	31
20-30	81	38	162	11	98	27	4	19
30-40	59	52	123	23	132	39	11	23
40-50	61	39	129	15	141	43	9	18
50-60	80	31	105	17	103	28	13	33
Total	**423**	**261**	**813**	**101**	**707**	**207**	**50**	**151**

Day-1

Site & Location : Airport to House building

Date : 14.04.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table 4.2

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	74	45	185	16	112	33	6	27
10-20	68	56	109	19	121	37	7	31
20-30	81	38	162	11	98	27	4	19
30-40	59	52	123	23	132	39	11	23
40-50	61	39	129	15	141	43	9	18
50-60	80	31	105	17	103	28	13	33
Total	**423**	**261**	**813**	**101**	**707**	**207**	**50**	**151**

Day- 2

Site & Location : Airport To House-Building

. Date : 15.08.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table 4.3

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	74	51	102	23	187	67	28	38
10-20	63	77	110	32	172	55	26	25
20-30	84	100	126	21	123	37	22	29
30-40	51	58	98	35	185	62	32	18
40-50	78	115	128	26	165	76	19	20
50-60	68	84	98	18	118	81	15	23
Total	**418**	**485**	**662**	**155**	**950**	**378**	**142**	**153**

Day- 2

Site & Location : House-Building To Airport

Date : 15.08.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot and Sunny day

Data Collection Table 4.4

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	72	64	130	19	116	46	25	39
10-20	67	78	115	25	131	52	15	43
20-30	53	91	105	29	167	27	25	61
30-40	105	59	98	16	119	33	18	37
40-50	48	81	125	23	103	38	29	31
50-60	81	57	107	35	128	49	35	40
Total	**426**	**430**	**680**	**147**	**764**	**265**	**147**	**251**

Day- 3

Site & Location : House-Building To Airport

Date : 16.04.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table 4.5

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	56	72	181	24	204	45	18	31
10-20	81	69	179	21	209	37	25	42
20-30	63	96	105	32	158	26	17	37
30-40	53	58	163	18	108	32	20	47
40-50	62	105	191	27	127	42	30	36
50-60	75	92	118	38	99	52	29	51
Total	**390**	**492**	**937**	**160**	**905**	**244**	**139**	**197**

Day- 3

Site & Location : Airport To House-Building

Date : 16.04.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table 4.6

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	77	68	105	18	187	52	25	47
10-20	82	71	215	28	212	36	28	37
20-30	52	105	168	15	118	45	32	28
30-40	68	119	105	28	126	37	23	35
40-50	57	87	138	32	115	62	41	31
50-60	49	93	121	39	103	49	21	24
Total	**385**	**543**	**852**	**160**	**861**	**281**	**170**	**202**

Day- 4

Site & Location : House-Building To Airport

Date : 17.04.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table 4.7

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	70	68	135	27	215	28	25	25
10-20	87	107	115	19	195	32	32	23
20-30	68	98	129	42	118	39	30	18
30-40	53	81	151	39	131	41	25	32
40-50	76	85	78	25	111	47	22	42
50-60	58	92	102	32	98	26	32	25
Total	**412**	**531**	**710**	**184**	**868**	**213**	**166**	**165**

Day- 4

Site & Location : Airport To House-Building

Date: 17.08.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot sunny day

Data Collection Table 4.8

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	65	61	215	28	205	82	22	34
10-20	78	87	111	32	198	23	25	29
20-30	84	103	98	20	117	58	21	32
30-40	57	98	171	31	123	62	35	25
40-50	62	76	82	26	165	25	28	27
50-60	59	67	115	33	116	32	27	31
Total	**405**	**492**	**792**	**170**	**924**	**282**	**158**	**178**

Day -5

Site & Location : House-Building To Airport

Date: 18.08.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table 4.9

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	97	131	105	72	171	65	31	42
10-20	82	95	183	47	121	73	27	38
20-30	85	121	153	43	179	38	25	33
30-40	93	125	113	29	203	70	30	39
40-50	98	88	121	20	141	58	31	30
50-60	72	128	153	31	200	63	28	29
Total	**527**	**688**	**828**	**242**	**1015**	**367**	**172**	**211**

Day -5

Site & Location : Airport To House-Building

Date: 18.08.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table 4.10

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	81	77	191	36	116	46	25	38
10-20	110	99	141	32	145	78	22	35
20-30	93	70	139	43	113	32	32	31
30-40	38	112	182	40	153	58	29	33
40-50	75	123	118	48	138	61	30	21
50-60	61	93	193	33	162	49	28	42
Total	**458**	**574**	**964**	**232**	**827**	**324**	**166**	**200**

Day -6

Site & Location : House-Building To Airport

Date: 19.08.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table 4.11

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	83	93	192	59	232	53	25	45
10-20	108	67	128	48	189	61	31	48
20-30	129	53	203	35	221	49	23	37
30-40	119	91	232	31	130	72	29	35
40-50	108	89	115	59	193	53	28	40
50-60	100	110	189	49	224	69	30	43
Total	**647**	**503**	**1059**	**281**	**1189**	**357**	**166**	**248**

Day -6

Site & Location : Airport To House-Building

Date: 19.08.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table 4.12

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	112	77	143	69	121	57	23	47
10-20	117	59	167	52	93	41	27	35
20-30	107	73	185	61	143	55	19	39
30-40	92	60	151	49	175	47	7	42
40-50	98	107	110	22	136	49	25	29
50-60	118	82	127	78	148	63	31	30
Total	**644**	**458**	**883**	**342**	**816**	**312**	**132**	**222**

Day -7

Site & Location : House-Building To Airport

Date: 20.08.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table 4.13

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	163	56	133	46	141	34	27	39
10-20	131	62	121	35	137	42	21	36
20-30	147	87	152	23	161	50	28	30
30-40	93	79	110	41	223	47	29	40
40-50	105	93	136	60	153	38	20	32
50-60	87	76	160	37	113	52	19	37
Total	**726**	**453**	**812**	**242**	**928**	**263**	**144**	**214**

Day -7

Site & Location : Airport To House-Building

Date: 20.08.2021

Time : 4.30 Pm- 5.30 Pm

Weather Condition: Hot Sunny Day

Data Collection Table 4.14

Cycle (min)	Number of Vehicles							
	Bus	**CNG**	**Car**	**Truck**	**Motorcycle**	**Jeep**	**NMV**	**Utility**
0-10	98	82	127	60	193	51	21	30
10-20	105	93	136	45	188	48	17	36
20-30	122	87	190	42	147	36	14	26
30-40	100	103	147	50	171	42	28	22
40-50	123	79	150	53	98	62	19	36
50-60	119	61	205	66	181	59	27	40
Total	**667**	**505**	**955**	**316**	**978**	**298**	**126**	**190**

Direction: Avg. 7 Days House Building To Airport

Data CollectionTable:4.15

Cycle (min)	Number of Vehicles							
	Bus	CNG	Car	Truck	Motorcycle	Jeep	NMV	Utility
0-10	90	75	139	39	186	47	25	37
10-20	90	78	138	32	169	48	24	35
20-30	97	90	140	32	157	38	22	29
30-40	75	77	141	30	155	52	26	34
40-50	83	94	129	36	149	48	24	31
50-60	79	92	133	31	137	51	24	35
Avg. Data For 60 Min.	**514**	**506**	**820**	**200**	**953**	**284**	**145**	**201**

Direction: Avg 7 Days Airport to House-Building

Data CollectionTable:4.16

Cycle (min)	Number of Vehicles							
	Bus	CNG	Car	Truck	Motorcycle	Jeep	NMV	Utility
0-10	82	67	159	34	150	52	21	37
10-20	89	77	121	33	139	39	12	34
20-30	84	81	149	31	129	40	21	28
30-40	74	86	139	33	142	45	19	31
40-50	74	84	121	30	128	48	24	23
50-60	66	69	139	38	134	48	26	35
Avg. Data For 60 Min.	469	464	828	199	822	272	123	188

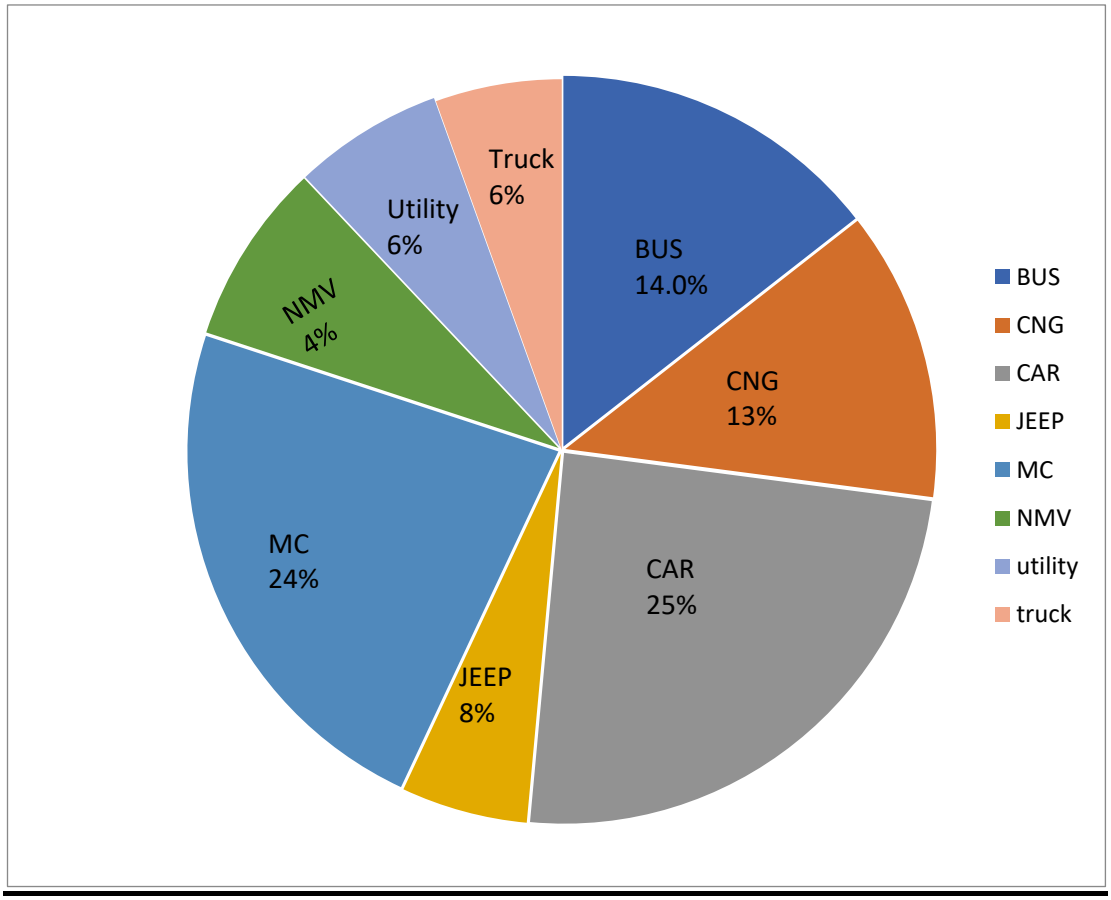
4.2Vehicle Composition (Airport To House Building)

Vehicle Classification		Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)		469	14	3	1407
Cng (C)		464	13	0.5	232
Car (LV)		828	25	1	828
Jeep/ Microbus/ Ambulance		272	8	1.5	408
Motorcycle (MC)		822	24	0.1	82.2
NMV		123	4	0.5	61.5
Utility		188	6	1.5	282
Truck (T)		199	6	3	597
Total =		3365	100		3897

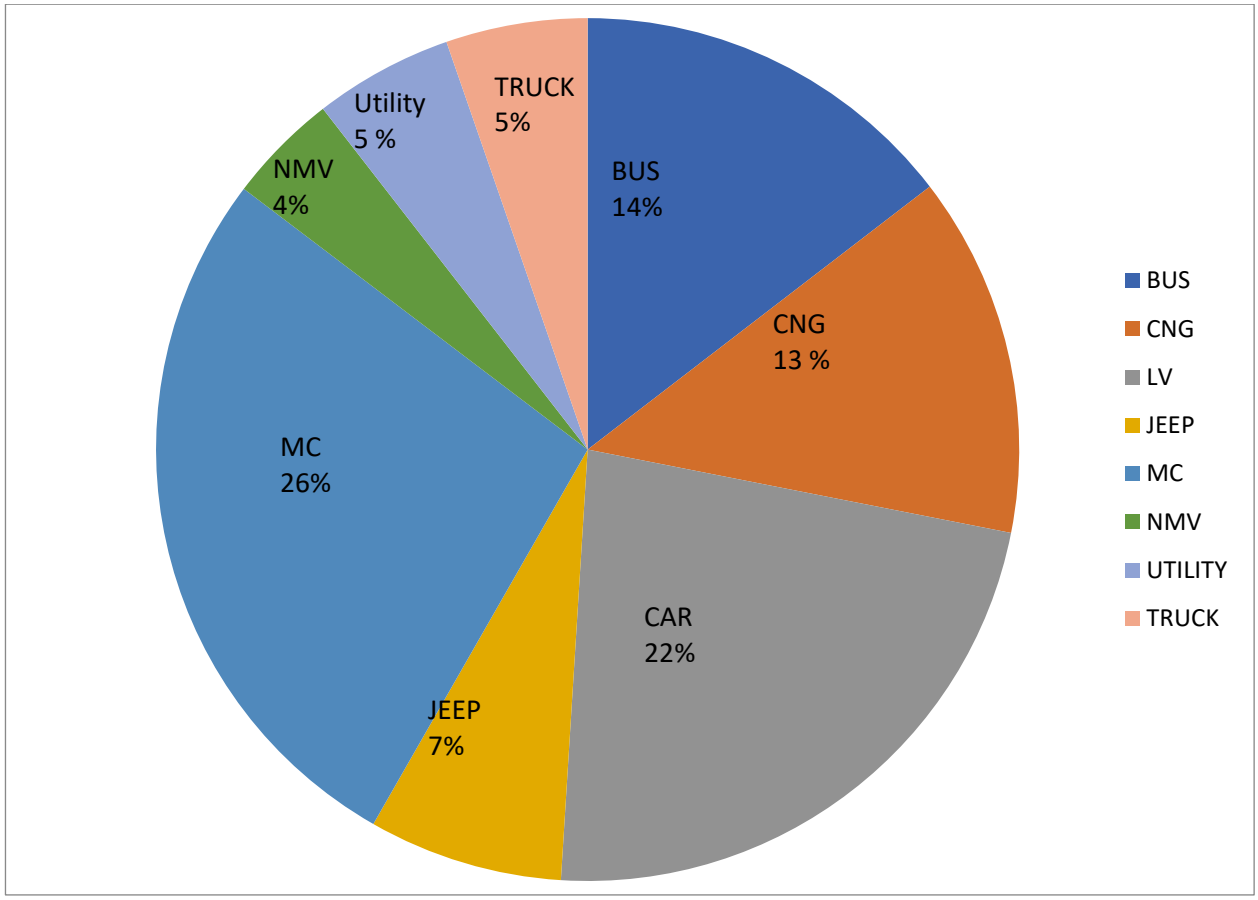
4.3Vehicle Composition (House Building To Airport)

Vehicle Classification		Hourly Volume	Vehicle %	PCU	Hourly PCU
Bus (B)		514	14	3	1542
Cng (C)		506	13	0.5	253
Car (LV)		820	22	1	820
Jeep/ Microbus/ Ambulance		284	7	1.5	426
Motorcycle (MC)		953	26	0.1	95.3
NMV		145	4	0.5	72.5
Utility		201	5	1.5	301.5
Truck (T)		200	5	3	600
Total=		3623	100		4110

4.4 Vehicle Composition (Airport To House Building)



4.5Vehicle Composition (House Building To Airport)



4.6 Directional Distribution

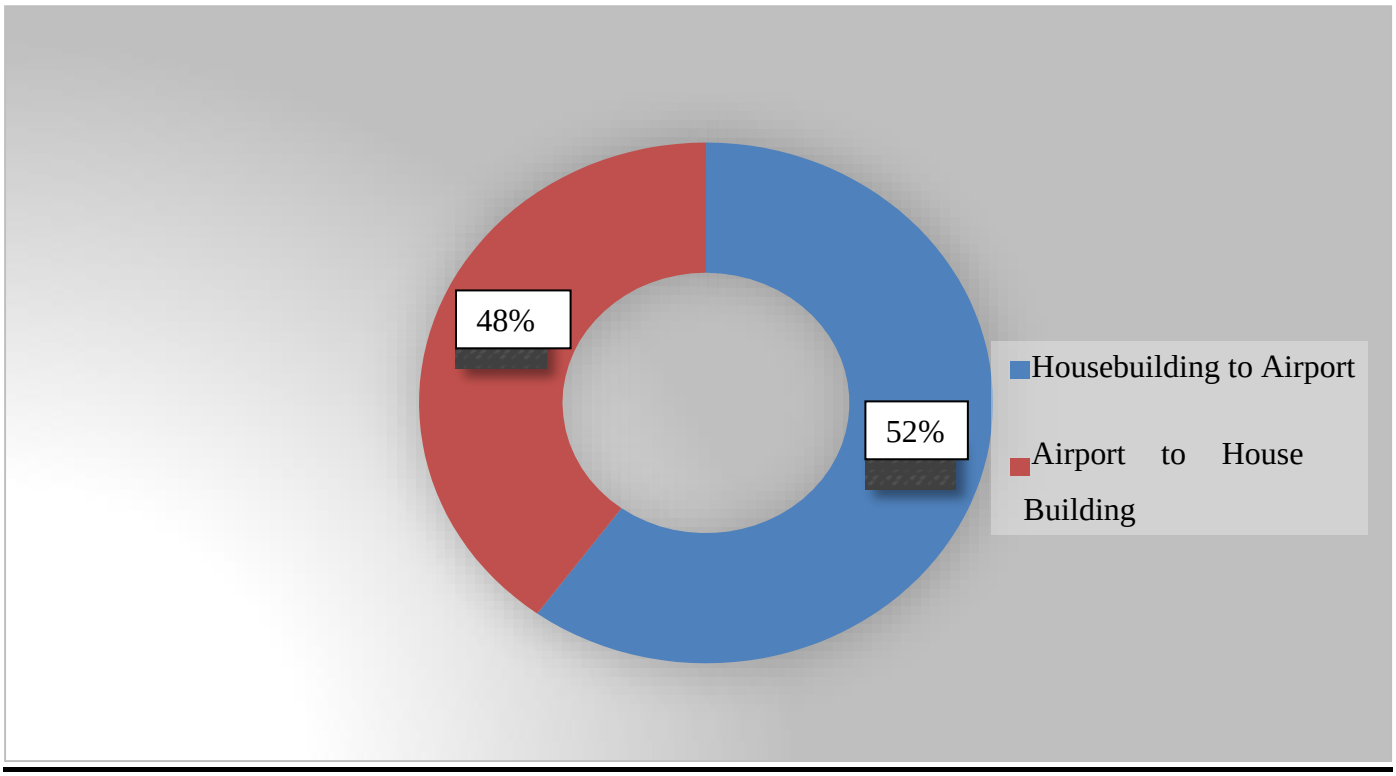
The directional Distribution is defined as the percentage of heavier volume over the total highway volume. This directional distribution is relevant only when designing or analyzing highways with two or more lanes in one direction. Directional distribution are used for capacity analysis, signal timing, justifying traffic control etc.

The directional distribution can be calculated from the data obtained by six groups as below:

Table 4.17: Directional Distribution

Direction	**Time**	**Average PCU/hr**	**Directional Distribution**
House building to airport	4:30PM-5:30PM	4110	52%
Airport to House building	4:30PM-5:30PM	3897	48%

4.7 Directional Distribution(%):



4.8 Overview

We see that hourly PCU for bus was airport to house building 1407 . however, house building to airport we found it bus was 1542 . For CNG hourly PUC was 232. house building to airport where in our study it was 253 .Again airport to house building car hourly PUC was 828 and we house building to airport found 820 in our study. Airport to house building for jeep/microbus/ ambulance 408 was . the value of hourly PUC house building to airport found 426 , for (airport to house building) motorcycle hourly PUC was 82.2 and we achieved (house building to airport)95.3. While counting the traffic volume airport to house building and house building to airport for utility 282 , 301.5. Truck 597 , 600 N M V 61.5 , 72.5

4.10 Service Flow Rate and Level of Service (LOS):

Service Flow Rate is the maximum hourly rate at which persons or vehicles reasonably can be expected to traverse a point or uniform segment of a lane or roadway during a given period under prevailing roadway, traffic, and control conditions while maintaining a designated level of service. The service flow rates generally are based on a 60 minute period. Typically, the hourly service flow rate is defined as four times the peak 60-minute volume. Service flow rate is the traffic parameter most commonly used in capacity and level-of-service (LOS) evaluations. Knowledge of highway capacity and LOS is essential to properly fit a planned highway or street to the requirements of traffic demand.

4.11 Loss Criteria:

LOS-A: Represents Free-flow condition; freedom to select travel speed; side-friction or interaction is very low; level of comfort and convenience is excellent.

LOS-B: Represents a zone of stable flow; reasonable freedom to select travel speed; Side- friction starts affecting and level of comfort and convenience is relatively lower.

LOS-C: Also a zone of stable flow; selection of speed is affected by others; Side-friction significantly affects the drivers and level of comfort and convenience declines noticeably.

LOS-D: Represents the limit of stable flow; freedom to select travel speed is severely affected; Side-friction severely affects the drivers and level of comfort and convenience is poor.

LOS-E: Represents close to the capacity level; average speeds are low but uniform; Side- friction causes forced maneuvers and level of comfort and convenience is extremely poor and driver frustration is high.

LOS-F: Represents zone of forced or breakdown flow; queue formation takes place (stop- and-go waves); delays results.

Passenger Car Equivalent (PCE) is a metric used in Transportation Engineering, to assess traffic-flow rate on a highway. A Passenger Car Equivalent is essentially the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single car.

Service Flow Rate 04:30 pm – 05:30 pm was 3897 PCU/hr from calculation it is found that the service flow rate 04:30pm to 05:30 pm was 4110 PCU/hr. Again, level of service of a road can be determined from service flow rate. Level of service of a road can be classified according to service flow rate as below.

Table 4.18: Service Flow Rate

LOS	Service Flow Rate (PCU/hr)
A	600
B	700
C	900
D	1200
E	1400
F	>1400

According to this table the level of service of the road was **'F'** at 04:30 pm-05:30 pm .

- The value of highest service flow is found 4110 PCU/ hour in the selected road. (In direction House Building to airport).
- According to the calculated service flow rate the level of service during the survey period was found F which indicates volumes, which is the area of unstable flow. Here operating speed is considered 75 mph. And service flow rate is considered at 100% of capacity.
- **Motorcycle** is the most dominant vehicle in the stream except in Composition of public transports like bus should be greater to minimize the traffic volume.

•Directional distribution values have been found fairly same. So, the geometric design of the road is perfect for present traffic. The highest value is found in the direction of that is Airport to House Building52%.

CHAPTER -5

CONCLUTION

5.1 Discussion on Vehicle Composition

In our study, light vehicle airport to house building was the predominant among the vehicle counted 25% percent of vehicles are of this category which is similar to the house building to airport was counted 26 % .We found that second most frequent vehicle category NMV that counts 4.00% in airport to house building and house building to airport 4% . Again, third most frequent vehicle category was bus , which consist 14% percent of total vehicle in both site. .The reason for high proportion of light vehicle is the proximity of the location to residential area of high income group people. The light vehicles were not highly occupied. But bus were almost fully occupied. It can be assumed that, more people were travelling by bus from distance places. Scarcity of public transport in this area gives rise to the dependency on NMV.

5.2 Limitations:

- Time and Resources is limited.
- Short count was taken (60 Min).
- Data could not be collected by Automatic Method.
- This volume study was practiced by manually which may lead to some errors in data collection process.

5.3 Recommendation:

- Limited use of personalized vehicles.
- The number of public transports should be increased.
- The number of NMV'S has to be restricted.
- Fitness of buses should be always monitored.
- Lanes should be designed keeping the directional distribution in mind.

5.4 Scope For Further Study Scope:

There are some shortcomings in the study. If these shortcomings can be overcome, more reliable and valuable data can be obtained. These shortcomings are described below-

This volume study was practiced by un-skilled enumerators, which may lead to some error in data collection process.

Data collected by manual method of counting, which is unreliable and irreversible.

5.5Conclusions:

•Although there were many limitations in our research, we can conclude that our survey was successful in addition to the lack of investment in the transport sector, primitive management system, distribution of non-uniform vehicles, such as a lot of research and learning.

•The analyzed data can be used to solve problem like traffic congestion in the road. It can also be used for signal designing, geometric design of roadway and improving level of service of the road.

•As there is scarcity of historical data, so from now data of all experiments have to preserve which will be really helpful in future.

REFERENCES

- Ahmed Al.Kaishy, Younghan Jung and Hesham Rakha. (2005), "Developing Passenger CarEquivalency Factors for Heavy Vehicles during Congestion". Journal of Transportation Engineering, ASCE, Vol. 131, No. 7, pp.514-523.

- Andrew P. Tarko, Rafael I. Perez –Cartagena, "Variability of a Peak Hour Factor at Intersections", Submitted for presentation at the 84 nd Annual Meeting of the Transportation Research Board, January 9- 13, 2005, Washington D.C.

- Arkatkar, S.S. (2011), "Effect of Intercity Road Geometry on Capacity under Heterogeneous Traffic Conditions Using Microscopic Simulation Technique", International Journal of Earth Sciences and Engineering, ISSN 0974-5904, Volume 04, No 06 SPL, October 2011, pp. 375-380.

- Basu, D., Maitra, S.R. and Maitra, B. (2006), "Modelling passenger car equivalency at an urban midblock using stream speed as measure of equivalence", European Transport TrasportiEuropei, Vol. 34, pp. 75-87.

- Chandra, S. and Prasad, N.V. (2004), "Capacity of Multialne Urban Roads under Mixed TraffiC Conditions", Highway Research Bulletin, Traffic Engg., Indian Road Congress, pp.97-103.

- Chandra S., Kumar, V., and Sikdar, P.K. (1995), "Dynamic PCU and Estimation of Capacity of Urban Roads", Indian Highways, Indian Road Congress, Vol. 23, No. 4, pp. 17 – 28.

- Ramanayya, T.V. (1988), "Highway Capacity under Mixed Traffic Conditions", Traffic Engineering and Control, Vol. 29, No. 5, United Kingdom, pp. 284- 300.

- Satyanarayana PVH, Durga Rani K, Gopala Raju SSSV, "Development of PCU factors and capacity norms at mid blocks of rural highways in Visakhapatnam", Indian J. Edu. Inf. Manage.,Vol. 1, No.5(May2012), ISSN 2277–5374, pp.197-202.

- Halder, S., Islam, M.A. & Alam, M.R.A. (2013), "Traffic Volume Study", Research Gate, DOI: 10.13140/RG.2.1.3063.752.

- Mahmud, M.F. (2013), "Traffic Volume Study" Research Gate, DOI: 10.13140/RG.2.1.4517.3601.

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