STAMFORD UNIVERSITY BANGLADESH

DEPARTMENT OF CIVIL ENGINEERING

A STUDY ON FLOW-DENSITY RELATIONSHIP AT KAKRAIL TO MOGHBAZAR ROUTE (BOTH DIRECTION)

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NOVEMBER, 2020

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A project and thesis by

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The project and thesis title **"A STUDY ON FLOW DENSITY RELATIONSHIP KAKRAIL TO MOGHBAZAR ROUTE IN (BOTH DIRECTION)** submitted by Md. Mahafuzur Rahaman**,** ID NO: CEN062 09396; Md. Shoykot Raihan, ID NO: CEN 062 09419; & Md. Mostofa Kamal, ID NO: CEN062 09471; student of the Department of Civil Engineering has been satisfactorily accepted in partial fulfillment of the requirements for the degree of Bachelor of science (B.sc) in civil Engineering on November, 2020.

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DECLARATION

We, Md. Mahafuzur Rahaman, Md. Shoykot Raihan & Md. Mostofa Kamal the student of B.Sc in Civil Engineering hereby solemnly declare that, the works presented in this thesis & project has been carried out by me and has not previously been submitted to any other University / college / Organization for any academic qualification / certificate / diploma / degree.

We warrant that the present work does not breach any copyright.

We, further undertake to indemnify the university against any loss or damage arising from breach of the foregoing obligations.

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DEDICATION

We dedicate this thesis to our parents and to all of our honorable faculties of Department of Civil Engineering, Stamford University Bangladesh.

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The research ‘A Study on Flow Density Relationship Kakrail to Moghbazar Route (Both Direction)’ has been conducted in partial fulfillment of the requirements for the degree of Bachelor of Science (B.Sc.) in Civil Engineering. This critical work came to life due to the unconditional help and co-operation in different ways by many people. We express our gratefulness and thank them for their assistance in preparation of this project and thesis.

First of all, we like to show my highest gratitude to the Almighty Allah SubhanaWaTa’la for his mercy, blessings and guidance while we were preparing our thesis.

It is the broadness of the government to pass the Private University Act 1993 for making a scope of education for all. It wouldn’t have been possible on my behalf to have earned the bachelor degree in civil engineering if a private university like Stamford University Bangladesh would not have taken the challenge to create civil Engineers. We are grateful to Prof. Dr. M. A. Hannan Feroz, the Honorable President and Vice Chancellor of the Stamford University Bangladesh for this praise worthy step.

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ABSTRACT

Deficiencies in present roadway network of Dhaka city have reached to such an alarming state where scopes of traffic improvement are getting confined day by day. Weak infrastructure has provoked heterogeneous mixing of vehicle along with non-lane based movement and no access control. Due to lack of proper implementation of transport planning and effective management, streets of Dhaka have become over numbered with vehicles and remain motionless for hours in both peak and off-peak periods. Identification of inherent weakness of interrupted traffic flow like total number of interruptions during a vehicle trip is prerequisite to confirm the smooth flow of vehicles and minimize the undesirable time killing of road users. The traffic system in the capital has gone back to its previous condition with the presence of illegal and unfit vehicles, picking and dropping passengers in the middle of road. The present study is concerned with traffic flow characteristic observed on Kakrail to Moghbazar both route Carriageway. In this study offers an explanation of the relationship between speed, density, flow and travel time models for uninterrupted and interrupted traffic flows. There was a lot of vehicles on the road during peak hour. But there was not much crowd on the road except peak hour during Corona (COVID19) pandemic situation. The roads of area was horizontal (flat) and geometrically straight and there had very little pedestrian. During study there was a huge traffic jam in study area. Data was taken total 200 vehicles for both direction. The total time was required 11.413 minutes during morning peak hour and other direction data was 11.113 minutes. Data was taken 14 September 2020 at peak hour in morning 9.00 am and another data was taken 5.00 pm. Data was collected at different times for the reason speed value are so much difference. The morning peak hour time the maximum flow occurred and the speed was 19.5 mph, on the other hand the evening peak hour time the maximum flow occurred and the speed was 20.25 mph.

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LIST OF ACRONYMS & ABBREVIATIONS

SMS = Space Mean Speed

SMA = Statistical Metropolitan Area

VPH = Vehicle per Hour

MPH = Mile per Hour

VPM = Vehicle per Mile

LOS = Level of Service

AHS = Average Highway Speed

PCU = Passenger Car Unit

ADT = Average Daily Traffic

AADT = Annual average daily traffic

CHAPTER ONE

INTRODUCTION

CHAPTER I

INTRODUCTION

1.1 General

Time mean speed and space mean speed are two important measures of speed. It is possible to have a relation between them and was derived in this chapter. Also, time mean speed will be always greater than or equal to space mean speed. The fundamental diagrams of traffic flow are vital tools which enables analysis of fundamental relationships. There are three diagrams - speed-density, speed-flow and flow-density.

1.2 Background

Dhaka or (Dacca) is the capital and largest city of Bangladesh. It is the cultural and economic hub of the country. Having a colossal historical background, the old part of the city, known as old Dhaka or Old Town, is home to a broad range of architectural heritage starting from the vestiges of the Mughal Empire to the British Colonial buildings. Being the center of the independence movements of Bangladesh, Dhaka also hosts some significant national monuments and structures. The modernization and development of Dhaka during the last couple of decades and a corrupt governing and middle class has made the development of international five star chain hotels profitable and spurred the building of some of the largest shopping malls in the world. Dhaka is a thriving, colorful and congested metropolis of 20 million people. Given the number of people that live there, and the density they live in, Dhaka is one of the most frenetic places on Earth. The streets and rivers are filled with colorful chaos. It also plays host to the highest number of rickshaws in any city in the world, total around 400,000; you certainly won't miss them. Experiencing the city for the first time can often seem overwhelming. Dhaka, the capital of Bangladesh, with more than 15 million people within its area of 360 square km, has emerged as one of the most congested, unsafe and polluted cities in the world today. The capital city relies on its road based transportation system. However, the roads of Dhaka are not well planned, designed, and operated to meet the dwellers mobility and accessibility needs.

A major portion of Dhaka's some 1868 km of roadways has no sidewalks and where the sidewalks do exist, they are very narrow, poorly maintained, and disjointed or broken. Buses are the only form of mass transit mode in Dhaka, and bus operators are mostly privately owned fragmented and unorganized companies. They provide substantially inadequate and very poor quality of bus service. For its very existence as a mega-city, Dhaka needs to develop a healthy transportation system to support its existing population as well as to maintain a sustained growth. Given the status-quo, this paper addresses six critical issues (e.g., transportation infrastructure and pedestrian, public transportation, growth management and control, education and research, governance and institutions, and funding and financing), and needs in light of developing sustainable transportation systems for Dhaka metropolitan city. A recent World Bank Study shows that Dhaka average Traffic Speed has dropped from 21Km/h to 7 km/h in the last 10 years. Slightly above the average Walking Speed. Traffic gridlock eats up 3.2 million Work hours per day. (Collect from Dhaka tribune). Traffic Flow theory involves the development of mathematical relationship among the primary element of traffic stream flow density speed volume data are needed to research planning designing and regulation phase of traffic engineering and are also used in establishing priority's and schedule of traffic movement. So the engineer must knowledge of Traffic volume characteristics and route distribution of volume for each area in Dhaka city.

1.3 Objective

The major objective of our study can be summarized as follow

- To evaluate and analyze the flow density relationship of the selected area in Dhaka city;
- To assess the flow parameter of an urban heterogeneous traffic and various roadway characteristics;

1.4 Scope of study

The traffic volume/flow, count study is carried out to get following useful information.

- Proportions of vehicle in the traffic stream
- Hourly, daily, yearly and seasonal variation of vehicular flows

- Flow fluctuation on different approaches at a junction or different parts of a road network system.
- If we remove or create another lane for non-motorized vehicle then we get a uncongested flow.

1.5 Organization of Thesis

Chapter One: The first chapter is Introduction which discusses the general information objectives, scope of study and summary of the survey work.

Chapter Two: Discusses about the Basic Concepts of flow Density relationship. It has been created about how traffic jam impact on traffic flow, various problem by traffic jam & Interventions to reduce traffic congestion.

Chapter Three: It discusses about the road selection in Dhaka city and Work procedure.

Chapter Four: It has been created about data collection and find value with various types of Graph on selected area.

Chapter Five: It presents the conclusions and limitation of study and recommendation.

1.6 Summary:

In road traffic, speed-flow curves describe the relationship between vehicle flow and average vehicle speeds. These functions are one of the basic elements of transport modeling. Speed-flow relationship has become timely in recent years as vehicle fleet changed, average traffic volumes increased and more comprehensive, automatic data collection became available. It is also used to find out the capacity of road finding these relationships at peak hour and (LOS) Level of Service, and also find speed limit for a particular road. The paper aims to examine the validity of the well-known fundamental diagram for Kakrail to Moghbazar (Both direction) roads, to provide an estimation for the speed flow curve based on the Dhaka city specific location.

CHAPTER TWO

LITERATURE REVIEW

CHAPTER II
LITERATURE REVIEW

2.1 General

The analysis of traffic conditions in macroscopic models are governed by fundamental relationships between flow, speed and density. Speed-flow-density relationships are the most useful tools in highway design and planning process. They are useful in predicting the roadway capacity, in determining the adequate level-of-service of traffic flow and in determining travel time for a specific roadway. The theory of traffic flow helps in description of the relationships between speed, flow and density for all conditions of traffic flow on different highways. Once a particular relationship between two traffic characteristics is established, unknown characteristic can be estimated. Mathematical relationships used to describe traffic flow can be classified into two approaches, the macroscopic approach and microscopic approach. The macroscopic approach considers the flow as a stream and it is concerned with macroscopic speed, flow and density, while the microscopic approach which considers traffic as a mixture of individual vehicles deals with individual speed, time and distance.

2.2 Review of Literature

A research from H Wang , D Ni, QY Chen, J Li - Journal of Advanced 2013 - Wiley Online Library. As the graphical and mathematical representation of relationships among traffic flow, speed, and density, the fundamental diagram has been the foundation of traffic flow theory and transportation engineering. Underlying the fundamental diagram is the speed–density relationship which was originally documented in Greenshields' seminal work and followed by a variety of equilibrium models over the past 75 years. Observed in these efforts was their deterministic nature striving to pursue two seemingly competing goals: mathematical elegance and empirical accuracy, the former of which is attractive to mathematical modeling of traffic dynamics, and the latter is required if such modeling is meant to be realistic. As a

Continued effort of such a pursuit, this paper presents a stochastic speed–density model. The motivation is twofold: first, it is desirable to have a model which achieves both goals reasonably and second, the stochastic model can potentially lead to probabilistic traffic flow modeling and prediction which is typically not offered by a macroscopic approach.

Kartik vermani & Tripta goyal, PEC university of Technology, June 2017

Jomy Thomas et al (2011) in his paper "VEHICLE CLASS WISE SPEED-VOLUME MODELS FOR HETEROGENOUS TRAFFIC" studied vehicle class-wise speed volume models for heterogenous traffic of six lane divided roads in Chennai city at the mid-block section by using micro- simulation model HETEROSIM which was calibrated according to the observed traffic conditions.

Balaji Ponnu et al (2013) in his paper "Vehicle Class-wise Speed Volume model for Three-lane Undivided Urban Roads" found that multi-class speed flow equations are more relevant to these types of facilities rather than single class flow speed models. It aims to study the traffic flow in a three-lane two-way undivided road in the city of Chennai through developing multi-class speed-flow relationships using both linear and Bureau of Public Roads (BPR) models.

Ashish Dhamaniya et al (2013) in his paper "Speed Prediction Models for Urban Arterials under Mixed Traffic Conditions" developed speed density relations for different vehicle type on urban arterial roads under mix traffic conditions in Chandigarh, Jaipur and Delhi using a set of simultaneous equations and established speed prediction models and also compares the manoeuvrability of a vehicle type.

Hiren V Patel et al (2013) in his paper "Capacity Determination of an Arterial Road" determined capacity of Modasa town in Gujarat by developing speed flow density relationships which can be helpful for working out improvement plans of the town and finding out the LOS of the road. XU Cheng et al (2014) in his paper "Analysis of Traffic Speed-Density Relation Model Characteristics" compared 10 typical speed density relation models and analysed by parameter calibrations and fitting errors on Beijing Expressway and found out that out of all, Newell and Logistic models showed good stability.

Chen Yu, Huazhong University of science and technology- 2016 January

As a fundamental traffic diagram, the speed-density relationship can provide a solid foundation for traffic flow analysis and efficient traffic management. Because of the change in modern travel modes, the dramatic increase in the number of vehicles and traffic density, and the impact of traffic signals and other factors, vehicles change velocity frequently, which means that a speed-density model based on uninterrupted traffic flow is not suitable for interrupted traffic flow. Based on the coil data of urban roads in Wuhan, China, a new method which can accurately describe the speed-density relation of interrupted traffic flow is proposed for speed fluctuation characteristics. The model of upper and lower bounds of critical values obtained by fitting the data of the coils on urban roads can accurately and intuitively describe the state of urban road traffic, and the physical meaning of each parameter plays an important role in the prediction and analysis of such traffic.

A Research from Jose M. del Castillo Department of Mechanical Engineering, University of Seville, Seville Spain

Three new models for the flow–density relationship are proposed in this work. The resulting flow–density curves are concave in the whole range of feasible values for the parameters. These models have four parameters, three of them being the jam density, the free-flow speed and the kinematic wave speed. The fourth parameter is a shape parameter. The models allow for a great flexibility for fitting of real traffic flow and density data. A remarkable property of these models is the fact that they yield a bilinear fundamental diagram when the shape parameter tends to infinity. The models have been tested with freeway data and urban data. The results demonstrate that the models achieve an excellent goodness of fit and yield realistic estimates of the parameters. The models proposed in this work are a valuable tool not only for fitting flow–density data but also for its use in traffic flow dynamic models.

RJ Salter, University of Bradford, UK

When considering the flow of traffic along a highway three descriptors are of considerable significance. They are the speed and the density or concentration, which describe the quality of service experienced by the stream; and the flow or volume, which measures the quantity of the stream and the demand on the highway facility.

A Research from Jose M. del Castillo Department of Mechanical Engineering, University of Seville, Spain. In this work a functional form for the speed-density relationship is presented. This functional form is made up of a non-dimensional spacing, the equivalent spacing and of a function, the generating function, whose argument is the equivalent spacing. This functional form is derived by means of two different arguments. The first argument is based on the set of properties that the volume-speed-density relationships should satisfy. The second one arises when applying a dimensional analysis to a generic car-following model. Finally, several examples of generating functions are shown.

A research from Hussain Hamid and Ahmad Farhan Modh Sadullah University Putra Malaysia, Establishing speed-flow-density relationships for exclusive motorcycle lanes

The motorcycle is a popular mode of transport in Malaysia and developing Asian countries, but its significant representation in the traffic mix results in high rates of motorcycle accidents. As a result, the Malaysian Government decided to segregate motorcycle traffic along its new federal roads as an engineering approach to reduce accidents. However, traffic engineers needed to know the maximum traffic a motorcycle lane could accommodate. Despite substantial literature related to speed–flow–density relationships and capacities of various transport facilities, there is a knowledge gap regarding motorcycle lanes. This paper establishes motorcycle speed–flow–density relationships and capacities of exclusive motorcycle lanes in Malaysia. Observations of motorcycle flows and speeds were conducted along existing and experimental motorcycle lanes. Motorcycle speed–density data were aggregated and plotted for two types of observable motorcycle riding behaviour patterns that were influenced by the widths of a motorcycle lane: the headway pattern (lane width $\leq$ 1.7 m) and the space pattern (lane width > 1.7 m). For both riding patterns, regression analysis of Motorcycle speed–density data best fits the logarithmic model and consequently the motorcycle flow–density and speed–flow models are derived. Motorcycle lane capacities for headway and space riding patterns are estimated as 3300 mc/hr/lane and 2200 mc/hr/m, respectively.

Xingliang Liu, Jinliang Xu, menghui Li, highway school, Chang'an University, china (General-Logistic-Based Speed-Density Relationship Model Incorporating the Effect of Heavy Vehicles)

Owing to its mathematical elegance and empirical accuracy, the speed-density model is critical in solving macroscopic traffic problems. This study developed an improved general-logistic-based speed-density model, which is a new method in macroscopic traffic flow theory. This article extensively discusses the properties of the general-logistic-based speed-density model. The physical meanings and values of all the parameters were determined based on the effect of heavy vehicles and the method for the linear and nonlinear regression analysis. The accuracy and versatility of the developed model were also found to be excellent based on the field data and relative error.

2.3 Basic Concepts of flow, Density, speed & space mean speed

Speed

It is measured as the ratio of distance to the time in which the distance was covered. Speed is a scalar quantity as it has only direction and no magnitude.

$$Us = \frac{L}{T}$$

Where,

L=Total length (ft)

T=Time (sec)

The second fundamental traffic flow characteristic is speed. There are two ways to measure speed; Time-mean-speed (TMS) and space-mean-speed (SPS). TMS is calculated from the individual speed recorded for vehicles passing a point over a selected time period. We calculate SMS by dividing the average travel time by the measured distance.

Speed and travel time are fundamental measurements of a highway's traffic performance and speed is a key variable in the design of roadway facilities. Engineers also use it in LOS determination, accident analysis, economic studies, and most traffic engineering studies.

Given the design, demand, and control along a highway system, most analytical models of traffic use speed and travel time as the measure of system performance. Some models use speed or travel time as an input for the estimation of fuel consumption, vehicle emissions, and traffic noise.

Time Mean Speed (TMS)

Time mean speed is the average of all vehicles passing a point over a duration of time. It is the simple average of spot speed. Time mean speed is found by

$$\bar{u}_i = \frac{1}{n}\sum_{i=1}^{n} u_i$$

TMS is calculated from the individual speed recorded for vehicles passing a point over a selected time period.

Where,

n = number of vehicles passing a point on the high-way

u_i = Speed of the vehicle (ft/sec)

Space Mean Speed (SMS)

Space mean speed is defined as the harmonic mean of speeds passing a point during a period of time. It also equals the average speeds over a length of roadway. It is obtained by dividing the total distance travelled by two or more vehicle on a section of highway by the total time required by these vehicles to travel that distance. This is the speed that is involved in flow, density relationship. Space mean speed is found by,

$$\bar{u}_s = \frac{n}{\sum_{i=1}^{n}(\frac{1}{1/u_i})}$$
$$= \frac{n}{\sum_{i=f1}^{n}(t_i)}$$

Where,

$\bar{u}_s$ = Space mean speed (ft/sec)

u = Number of vehicles

t_i = the time it takes the vehicle to travel across a section of highway (sec)

u_i = Speed of vehicle (ft/sec)

L= Length of section (ft)

Density

Traffic density is the third fundamental traffic flow characteristic. It is an important characteristic that engineers can use in assessing traffic performance from the point of view of users and system operators. Engineers also employ it as the central variable in freeway control and surveillance systems. For example, the 1994 Highway Capacity Manual (HCM) uses traffic density as the primary LOS measurement for uninterrupted flow situations (freeways and highways). Traffic density also plays an important role in system-wide traffic performance evaluations and on-line traffic-responsive freeway control systems.

We define traffic density as the number of vehicles occupying a unit length of roadway. The easiest way to visualize traffic density is to consider an aerial photograph of a highway section. Count the number of vehicles in 100 m of a single lane at Kakrail to Moghbazar.

This will be the density per lane-mile. Traffic densities vary from 0 (no flow) to values representing stopped, bumper to bumper traffic. This upper limit, called jam density, is normally around 600-800 vehicles per lane-mile at Kakrail to Moghbazar road in Dhaka city, & also depending on the traffic composition and the clear gaps between vehicles.

For example, if the average distance headway under these conditions (the distance between front bumpers of two consecutive vehicles) is 25 feet, the jam density would be about 211 vehicles per lane-mile. The earlier-mentioned jam density range of 185 to 250 vehicles per mile implies an average distance headway of 21.1 to 28.5 feet per vehicle. Analysts can easily obtain the relationship between traffic density and average distance headway from the following equation:

$$K=\frac{n}{L} \times 5280$$

Where,

N = The number of vehicle passing a point the road way in T sec

L = Total Length (ft)

Flow (q)

Flow is one of the most common traffic parameters. Flow is the rate at which vehicles pass a given point on the roadway, and is normally given in terms of vehicles per hour. The 15-minute volume can be converted to a flow by multiplying the volume by four. If our 15-minute volume were 100 cars, we would report the flow as 400 vehicles per hour. For that 15-minute interval of time, the vehicles were crossing our designated point at a rate of 400 vehicles/hour.

Peak hour

A rush hour or peak hour is a part of the day during which traffic congestion on roads and crowding on public transport is at its highest.

The time of Dhaka city Peak hour is usually from 8am to 10 am in morning & 6 pm to 8pm in evening.

Time Headway

Time headway difference between the time when the front of a vehicle arrives at a point on the highway and the time the front of the next vehicle arrives at the same point (in seconds).

Speed Headway

Space headway difference in position between the front of a vehicle and the front of the next vehicle (in meters)

Spacing (s)

Spacing is the physical distance, usually reported in feet or meters, between the front bumper of the leading vehicle and the front bumper of the following vehicle. Spacing complements headway, as it describes the same space in another way. Spacing is the product of speed and headway.

Gap (g)

Gap is very similar to headway, except that it is a measure of the time that elapses between the departure of the first vehicle and the arrival of the second at the designated test point. Gap is a measure of the time between the rear bumper of the first vehicle and the front bumper of the second vehicle, where headway focuses on front-to-front times. Gap is usually reported in units of seconds.

2.4 Fundamental Diagram of traffic Flow:

Traffic flow is the study of interactions between travelers (including pedestrians, cyclists, drivers, and their vehicles) and infrastructure (including highways, signage, and traffic control devices), with the aim of understanding and developing an optimal transport network with efficient movement of traffic and minimal traffic congestion problems.

Attempts to produce a mathematical theory of traffic flow date back to the 1920s,

When Frank Knight first produced an analysis of traffic equilibrium, which was refined into Wardrop's first and second principles of equilibrium in 1952. The fundamental diagram of traffic flow is a diagram that gives a relation between the traffic flux (vehicles/hour) and the traffic density (vehicles/km). A macroscopic traffic model involving traffic flux, traffic density and velocity forms the basis of the fundamental diagram.

It can be used to predict the capability of a road system, or its behavior when applying inflow regulation or speed limits.

Basic Premises

- There is a connection between traffic density and vehicle velocity: The more vehicles are on a road, the slower their velocity will be.
- To prevent congestion and to keep traffic flow stable, the number of vehicles entering the control zone has to be smaller or equal to the number of vehicles leaving the zone in the same time.
- At a critical traffic density and a corresponding critical velocity the state of flow will change from stable to unstable.
- If one of the vehicles brakes in unstable flow regime the flow will collapse. The primary tool for graphically displaying information in the study traffic flow is the fundamental diagram. Fundamental diagrams consist of three different graphs: flow-density, speed-flow, and speed-density. The graphs are two dimensional graphs. All the graphs are related by the equation "flow = speed * density"; this equation is the essential equation in traffic flow. The fundamental diagrams were derived by the plotting of field data points and giving these data points a best fit curve. With the fundamental diagrams researchers can explore the relationship between speed, flow, and density of traffic.

Speed-density

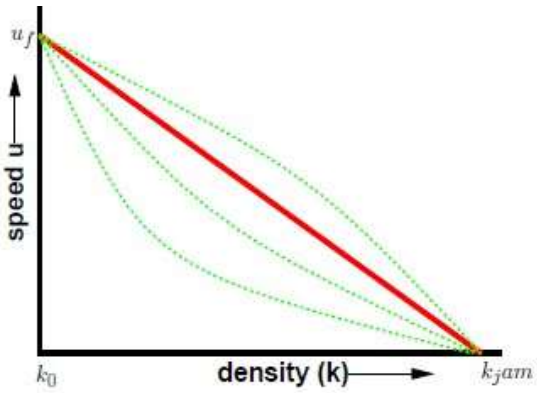

Figure 2.4.1: Speed Vs Density

The speed-density relationship is linear with a negative slope; therefore, as the density increases the speed of the roadway decreases. The line crosses the speed axis, y, at the free flow speed, and the line crosses the density axis, x, at the jam density. Here the speed approaches free flow speed as the density approaches zero. As the density increases, the speed of the vehicles on the roadway decreases. The speed reaches approximately zero when the density equals the jam density.

Flow-density

In the study of traffic flow theory, the flow-density diagram is used to determine the traffic state of a roadway.

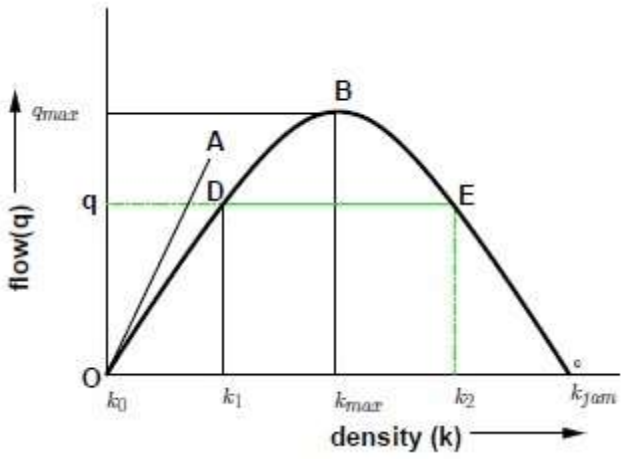

Figure 2.4.2: Flow Vs Density

Currently, there are two types of flow density graphs. The first is the parabolic shaped flow-density curve, and the second is the triangular shaped flow-density curve. Academia views the triangular shaped flow-density curve as more the accurate representation of real world events. The triangular shaped curve consists of two vectors. The first vector is the free flow side of the curve. This vector is created by placing the free flow velocity vector of a roadway at the origin of the flow-density graph. The second vector is the congested branch, which is created by placing the vector of the shock wave speed at zero flow and jam density. The congested branch has a negative slope, which implies that the higher the density on the congested branch the lower of the flow; therefore, even though there are more cars on the road, the number of cars passing a single point is less than if there were fewer cars on the road.

The intersection of free flow and congested vectors is the apex of the curve and is considered the capacity of the roadway, which is the traffic condition at which the maximum number of vehicles can pass by a point in a given time period. The flow and capacity at which this point occurs is the optimum flow and optimum density, respectively. The flow density diagram is used to give the traffic condition of a roadway. With the traffic conditions, time-space diagrams can be created to give travel time, delay, and queue lengths of a road segment.

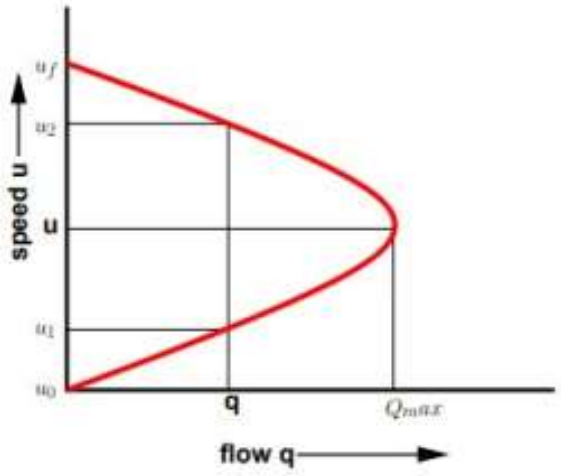

Figure 2.4.3: Speed Vs Flow

Speed – flow diagrams are to determine the speed at which the optimum flow occurs. There are currently two shapes of the speed-flow curve. The speed-flow curve also consists of two branches, the free flow and congested branches.

The relationship between the speed and flow can be postulated as follows. The flow is zero either because there is no vehicles or there are too many vehicles so that they cannot move. At maximum flow, the speed will be in between zero and free flow speed. The maximum flow Qmax occurs at speed u. It is possible to have two different speeds for a given flow.

2.5 How to People Face Problems

The plight of passengers travelling on the route between Kakrail route to Moghbazar route knows no bound as long tailback has become a permanent phenomenon on this busy road.
Travelling this 1-1.5 Kilometers distance takes one and a half hours on average. But it is supposed to take 15 to 20 minutes should there be a commute without any traffic jam.
Office-goers, students and even patients continue to suffer for the traffic tangles, especially during the morning and evening peak hours, to reach their destinations.
Local people blamed the construction works by WASA, and traffic system intersection and dilapidated roads for such traffic congestion on the route.
From early hours to midnight, a number of such human haulers remain parked in and around the Viqarunnisa Noon School, hindering smooth movement of traffic and causing tailback of traffic.
The similar scenario is seen on other busy roads and thoroughfares in the capital including Mirpur-Farmgate road, Gabtali-Newmarket road, Mohakhali-Airport road, Gulistan-Jatrabari road, and Malibagh to Kakrail and Purana Paltan roads.

Traffic congestion in Dhaka eats up around 5 million working hours every day and the average speed of vehicles during rush hours has come down to 5 kmph, according to the Accident Research Institute of BUET.

Figure 2.5.1: Illegal Parking

Experts say the government should take pragmatic steps, including ensuring sufficient mass transport and restoring discipline in the transport sector, to tackle the situation. Despite the construction of several flyovers, allowing people to park their vehicles on designated streets and bus stops, and stern action against wrong-side driving, traffic congestion in Dhaka continues to aggravate, causing serious sufferings to city commuters. According to Dhaka Metropolitan Police (DMP) Traffic Department, traffic jam has become intolerable over the last few days in some city areas, including Malibagh-Kuril Biswa road, Mirpur-12 to Mirpur-10 crossing, Rokeya Sarani, Gulshan, Banani, Badda, Moghbazar, Eskaton, Tejgaon, Airport Road and Uttara, for many reasons, including the ongoing construction works for setting U-loop at Badda, metro rail construction work and rise in private vehicles and slow-moving rickshaws on the streets.

Figure 2.5.2: Interrupted Traffic System

Transport and urban experts think the government should take pragmatic steps to ensure sufficient mass transport, restore discipline in the transport sector, reduce the use of private and small vehicles, replace the microbuses and minibuses with single-decker, double-decker and articulated buses and expand the city to significantly ease the traffic jam.

The experts also said the railways and waterways can also be used effectively to ease traffic pressure on roads and facilitate the commuters to use stations, passenger sheds and public vehicles alongside the traffic mismanagement.

Figure 2.5.3: People Do Not Use Foot-Over Bridge

Although the government implemented a few mega projects, including construction of a number of flyovers across the city, the city's traffic movement had not improved significantly. At the same time, traffic signals and countdown timers installed in the capital have been of no use as the traffic police continue to regulate traffic flows manually. Manual traffic controls usually encourage drivers and commuters to disobey rules.

Moreover, BRTA data shows a total of 87,795 unfit motor vehicles are plying across the roads of Dhaka, posing a threat to road safety and contributing to traffic congestion.

2.6 Impact of Traffic Congestion on Traffic Flow

Traffic congestion is a condition in transport that is characterised by slower speeds, longer trip Times and increased vehicular queueing**.** When traffic demand is great enough that the interaction between vehicles slows the speed of the traffic stream, this results in some congestion if the vehicles are running slow then naturally vehicles flow, speed also decreased. So the vehicles performance depends on traffic condition.

2.7 Interventions to Reduce Traffic Congestion

- Optimise traffic-light management
- Use CCTV to monitor road conditions
- Enforce existing road traffic laws
- Improve perceptions of buses
- Extend residents' parking zones
- Charge for workplace parking
- Improve cycling infrastructure
- Improve bus services
- Develop and refine park-and-ride
- Use Inbound Flow Control
- Rationalise distribution and deliveries
- Existing rail network
- Light rail
- Strategic Road Network resilience
- Road pricing
- Improve traffic system
- Pedestrian must use foot over bridge.

2.8 Summary

This chapter represents review of the literature the basic concept of flow, density relationship development a fundamental diagram of traffic flow which will be helpful to understand the traffic management process of the selected area. We have already shown solutions of traffic jam from different perspectives. And there are some common solution depicted by general people, vehicle operators or experts. So, we are summarizing the solutions in one directed way so that our focus can be unidirectional. We want to reduce traffic jam using resources that are within our limit. And government should take steps to remove traffic problems in our life.

CHAPTER THREE

METHODOLOGY

CHAPTER III

METHODOLOGY

3.1 Introduction

In this chapter we have discussed the comprehensive study of one way to lanes operation. The development of the methodology used microscopic simulation field data, and theoretical planning. This is very important part of the total system of methodology. We will discuss further in this chapter how we observed the road. Investigation of roads, lanes, intersection, the traffic data at specific route and collect data and calculates all of them using face to face technique imperial data were collected for the study by sample survey method.

3.2 Flow Chart of Methodology

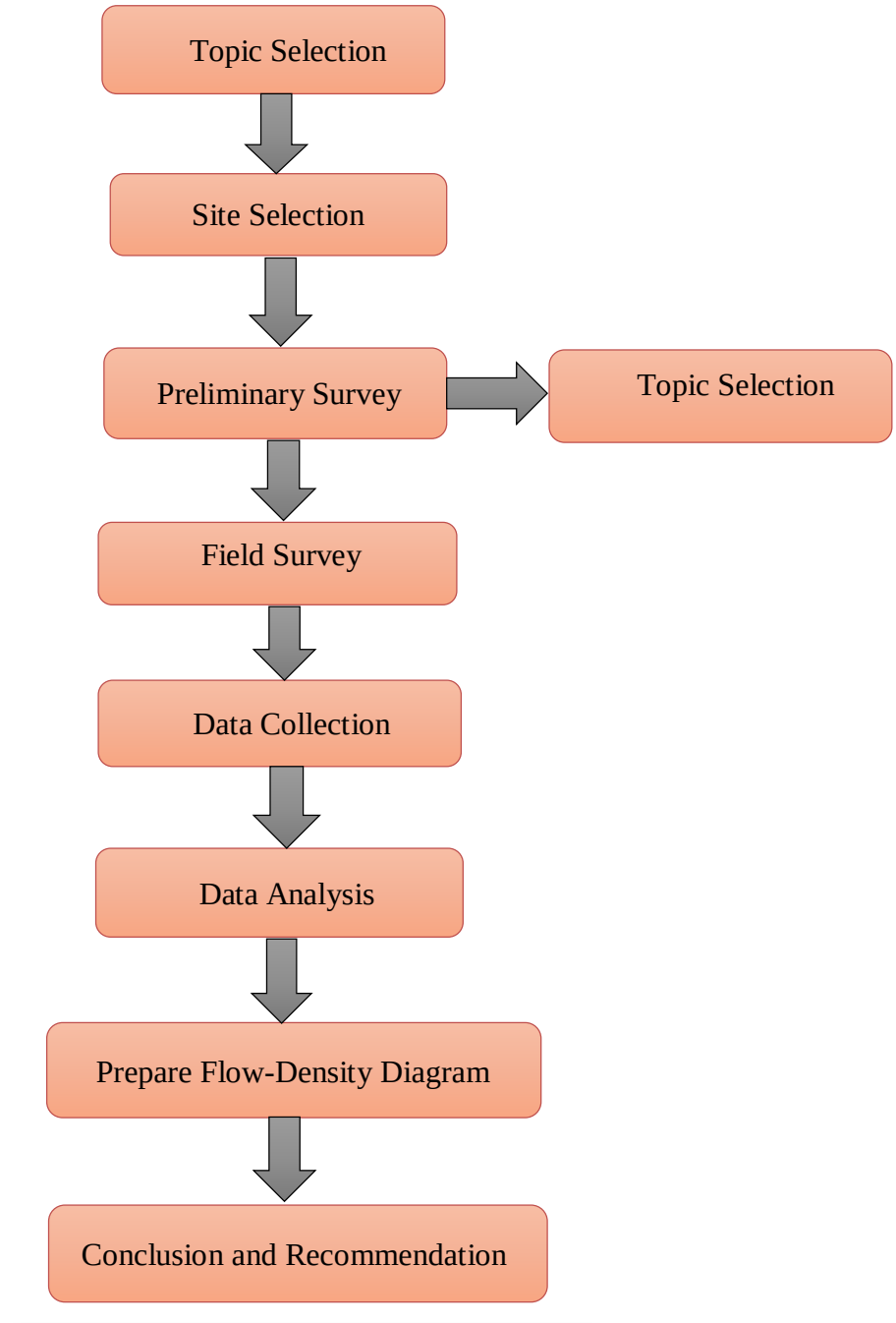

Figure 3.2.1: Flow Chart of Methodology

3.3 Selection of study Area

Figure 3.3.1: Baily Road and officers` club intersection

Our selection area is Baily road and Officers` club intersection. It is the middle intersection between Kakrail and Moghbazar intersections, so it is the another most important route in this area. It is one of the busiest intersections in Dhaka metropolitan, where traffic volume is so high.

Figure 3.3.2: Kakrail intersection

Figure 3.3.3: Live picture in Baily road and Officers` Club intersection during pick hour.

Figure 3.3.4: Kakrail to Moghbazar live picture during movement of vehicles.

Figure 3.3.5: Live picture in Moghbazar Route

Figure3.3.6: Officer's club entry

Figure 3.3.7 : During 100m length measuring

Figure 3.3.8 : When crossing the specific line

Figure 3.3.9 : Foot-over bridge

Figure 3.3.10: Zebra crossing

3.4 Methodology

Methodology is the systematic, theoretical analysis of the methods applied to a field of study. It comprises the theoretical analysis of the body of methods and principles associated with a branch of knowledge. Flow chart of methodology is the important part of the study. The roads which have been chosen for study area are kakrail to Moghbazar in both directions.

3.4.1 Topic Selection

Flow density relationship is one of the major important branch to control traffic condition. It's also important parameters to evaluate the traffic management in any route. Topic selection is the first and important thing of a research. We know that Bangladesh has an amazing range of vehicles-on any highway we can see buses, cars, rickshaws, CNGs, motorbikes etc. Transport is an important part of Bangladesh economy so we selected the topic is a study on flow density relationship Kakrail to Moghbazar route in both direction.

3.4.2 Site selection

We selected this route because of this route is the most important road for Dhaka city. This is the middle intersection between Kakrail and Moghbazar route. And this site is more suitable for collect data.

3.4.3 Preliminary survey & photographic survey

After topic and site selection it is needed to go for a preliminary survey at the study area. This is important for analysis and gain a primary knowledge. Our road-way pattern was two lanes which width was 26 ft. measured by a tape and opposite direction two lanes and 24ft and footpath was 6 ft. in both sides and captured some picture such as traffic light, foot-over Bridge, intersection, zebra crossing etc. Photographic survey also called photograph icing is a method of surveying in which plans or maps are prepared from photographic taken at a suitable camera. Photographic is the science of making measurement from photographs.

3.4.4 Field survey

The initial step was the selection of the road stretch, from which the data were collected. The road selected was kakrail to Moghbazar road in both direction (see Fig. 3.2.2). The next step was the selection of the study section on the selected road in which the entry point and exit point are marked. A pilot study was organized on the selected road which covers both free-flow and congested-flow conditions in order to determine the place were predictable to get

the data more precisely. The distance enclosed by the entry and exit point is noted as 100 m. The data were collected by hand survey conducted on peak hour in morning and evening .field survey is the collection and gathering of information at the location by conducting primary survey. These are an essential component of geographic enquiry and are carried out through observation, interviews, sketching, measurement etc.

3.4.5 Data Collection

After preliminary and field survey, data was collected which are taken manually and need a extra attention because data need to be taken carefully. Data of taken 100 vehicles were taken and both direction total 200 vehicles were taken. And total time required 11.413 minutes and opposite's direction data collection time was 11.113 minutes and data was taken 14 Sep 2020 at peak hour in morning 9 am and another data was taken 5 pm .the day was mostly sunny Like 31^0 C .

3.4.6 Data Analysis

The flow data is calculated at entry and exit points in such a way that the vehicles which are passing through the section in every five-minute interval. The speed data is done by calculating the time by which vehicle which enters and exit the rectangular section. Analysis of data which solved carefully because of the total study result depends on it and calculation should be handling properly. After set up all kind of information and analysis data correctly then get a final result.

3.4.7 Prepare Flow Density Diagram

When get a final result and all kind of correct information then prepare flow density, speed density, space mean speed-flow diagram that was shown in next chapter.

3.4.8 Conclusion

The research methodology and results presented here offer insight into fundamental traffic relations, suggesting that the flow-density curve can be substantially influenced by roadway users, their vehicles, and weather conditions. As shown here, a flow-density model's predictive power rises significantly when one supplements density data with other relevant information, and most variables examined produce results that are highly statistically significant and intuitively acceptable.

3.5 Summary

This chapter represents the flow chart of study and selection of study area which was shown in map and takes some useful photo in study area and a short of description in flow chart.

CHAPTER FOUR

DATA COLLECTION AND ANALYSIS

CHAPTER IV
DATA COLLECTION AND ANALYSIS

4.1 General

The most common method of collecting traffic flow data is the manual method. So Data has been collected by manual method. All the data were collected by conducting filed survey.
And we are collecting data from Kakrail to Moghbazar in both direction. The aim of this study was too observed and identifies flow density relationship. To field surveys also included various types of vehicles, there are car, bus, CNG, truck, motorcycle, pickup, ambulance etc. when the data was collected the day was Mostly sunny Like 31^0 C . And the data was collected during Peak hour. Total Length was taken 100m for both directions. And data was collected 11.413 minutes and opposite's direction data collection time was 11.113 minutes.

4.2 Data collection

It is essential to know the magnitude of traffic data required or to be collected, which will then determine its quality and type of vehicle classification to be adopted. Traffic counting falls in two main categories, namely; manual counts and automatic counts. There is no distinct difference between the two methods however, the economic use or selection of an appropriate method of traffic counting is a function of the level of traffic flow and the required data quality. A specific location for counting site (permanent or temporary) must be determined on site. The following should be kept in mind before deciding on the counting site:

- The road section should have uniform geometric characteristics along the road length and be away from junctions;
- Location should be on a horizontal (flat) and geometrically straight road section;
- Section of the road to have an uninterrupted traffic flow;
- Sections where telephone lines or radio (mobile) are easily accessible or can be installed, if possible;

- Section to have very little pedestrian;
- Section to meet safety requirements.

Vehicle's type pie chart for selected route (both direction)

Kakrail to Moghbazar Route

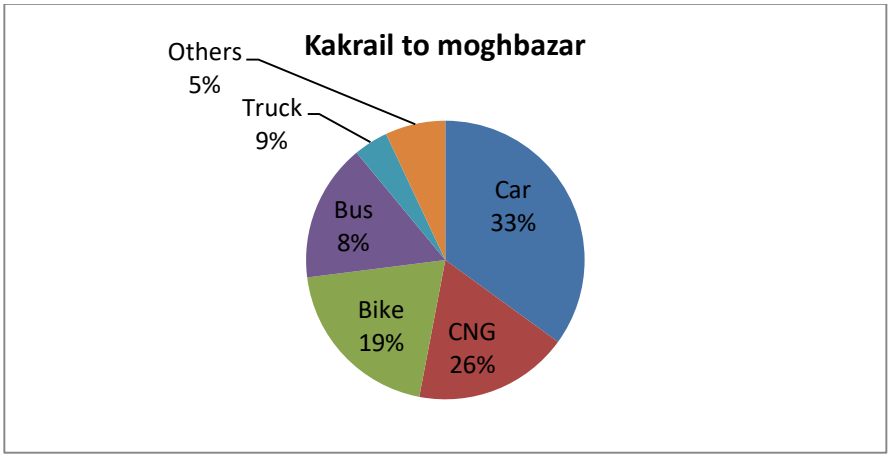

Figure 4.2.1: Kakrail to Moghbazar Pie Chart.

Moghbazar to Kakrail Route

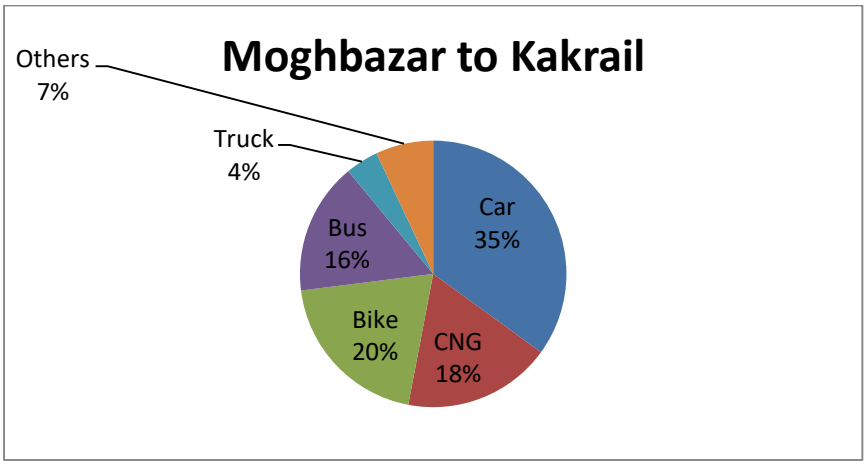

Figure 4.2.2: Moghbazar to Kakrail Pie Chart

4.3 Data Analysis

Speed:

We know,

$$Us = \frac{L}{T}$$

Where,

L= 100m

= 100×3.28

= 328 ft.

T = 7.98 sec (1st value from Table)

$$Us = \frac{L}{T}$$

$$= \frac{328}{7.98}$$

= 41.10 (ft/sec)

= 41.10 × 0.682

=28.03 (mph)

Similarly,

T = 7.58 sec (last value from Table)

$$Us = \frac{L}{T}$$

$$= \frac{328}{7.58}$$

= 43.27(ft/sec)

= 43.27 × 0.682

=29.51 (mph)

Density:

We know,

$$K=\frac{n}{L}\times 5280$$

When,

n=1

L=100 m

$=100\times 3.28$

=328 ft.

$$K=\frac{n}{L}\times 5280$$

$$=\frac{1}{328}\times 5280$$

= 16.09 (vpm)

Similarly,

n= 100

$$K=\frac{n}{L}\times 5280$$

$$=\frac{100}{328}\times 5280$$

= 1609.76 (vpm)

Flow:

We know,

$$Q=\frac{n\times 3600}{T}\text{ vph}$$

When,

N=1

T=7.98 sec (1st value from Table)

$$Q = \frac{n \times 3600}{T}$$

$$= \frac{1 \times 3600}{7.98(sec)}$$

$$= 451.13 \text{ (vph)}$$

Similarly when, n= 100

$$Q = \frac{n \times 3600}{T}$$

$$= \frac{100 \times 3600}{7.9+7.59+9.14.....+7.58}$$

$$= \frac{360000}{684.8}$$

$$= 525.70 \text{ (vph)}$$

Space Mean Speed (SMS):

We know,

$$\bar{u}_s = \frac{n}{\sum_{i=1}^{n}(\frac{1}{1/u_i})}$$

$$= \frac{n}{\sum_{i=f1}^{n}(t_i)}$$

When,

n = 1 (1st value from Table)

t_i= 684.8 sec

L=100 m

=100 × 3.28

=328 ft.

$$SMS = \frac{1 \times 328}{684.8}$$

= 0.4789 (ft/sec)

=0.4789×0.682

= 0.33 (mph)

Similarly,

n = 100

SMS = $\frac{100\times328}{684.8}$

= 47.90 (ft/sec)

=47.90×0.682

= 32.67 (mph)

4.4 Flow Density Analysis

Flow

Flow (q) is the number of vehicles passing a reference point per unit of time, vehicles per hour.

$$Q=\frac{n\times3600}{T} \text{ vph}$$

Where,

Q = The equivalent hourly flow (vph)

N= The number of vehicle passing a point the road way in T sec.

Density

Density is inversely proportional to the volume of traffic. If density is less, then speed will be more and traffic volume will be more. And if the density is greater, then the speed will be low and traffic volume will be less.

Whenever, traffic jam problem create at certain point, then by the consideration of the peak hour traffic volume, we may proceed towards widening of road, fly over or under pass.

$$K=\frac{n}{L} \times 5280$$

N= The number of vehicle passing a point the road way in T sec

L = Total length (ft.)

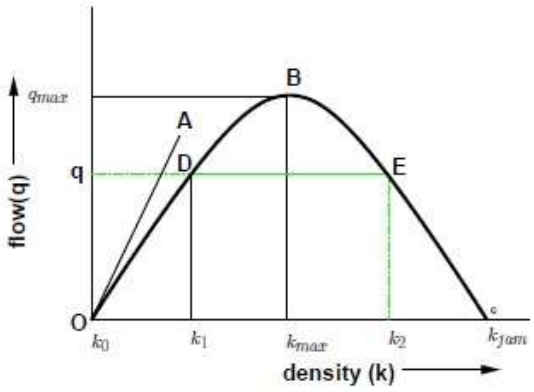

Figure 4.4.1: Flow Vs Density Diagram

The flow and density varies with time and location. The relation between the density and the corresponding flow on a given stretch of road is referred to as one of the fundamental diagram of traffic flow. Some characteristics of an ideal flow-density relationship is listed below:

1. When the density is zero, flow will also be zero, since there is no vehicles on the road.

2. When the number of vehicles gradually increases the density as well as flow increases.

3. When more and more vehicles are added, it reaches a situation where vehicles can't move. This is referred to as the jam density or the maximum density. At jam density, flow will be zero because the vehicles are not moving.

4. There will be some density between zero density and jam density, when the flow is maximum. The relationship is normally represented by a parabolic curve as shown in figure.

4.5 Tabular Form of Flow Density Analysis

Flow, density, speed calculation for Kakrail to Moghbazar Route in a tabular form is given Below where the total length were taken 100m by tape and time was taken 11.413 minutes.

Table1: Flow density calculation for Kakrail to Moghbazar Route.

Sl. No.	Vehicle name	Road Length(m)	Time(Sec)	speed(mph)	Density(vpm)	Flow(vph)	SMS(mph)
1	Car	100	7.98	28.03	16.09	451.13	0.33
2	CNG	100	7.59	29.47	32.19	462.43	0.65
3	Car	100	9.14	24.47	48.29	437.07	0.98
4	Bike	100	7.8	28.68	64.39	442.94	1.31
5	Car	100	8.67	25.8	80.48	437.11	1.63
6	CNG	100	7.55	29.62	96.58	443.26	1.95
7	Bike	100	7.22	30.98	112.68	450.4	2.29
8	Micro Bus	100	7.5	29.82	128.78	453.9	2.61
9	Truck	100	8.52	26.26	144.87	450.19	2.94
10	Car	100	6.57	34.04	160.97	458.37	3.27
11	Car	100	6.63	33.73	177.07	464.95	3.59
12	Car	100	5.92	37.78	193.17	474.26	3.91
13	Truck	100	6.15	36.37	209.26	481.28	4.25
14	Bike	100	7.98	28.03	225.36	479	4.57
15	Truck	100	5.49	40.74	241.46	487.76	4.9
16	Truck	100	8.44	26.5	257.56	483.42	5.23
17	Truck	100	8.04	27.82	273.65	481.17	5.55
18	Car	100	10.33	21.65	289.75	471.2	5.87
19	Bike	100	6.78	33	305.85	474.01	6.21
20	Truck	100	6.5	34.41	321.95	477.45	6.53
21	Car	100	6.98	32.05	338.04	479.15	6.86
22	CNG	100	6.37	35.12	354.14	482.49	7.19
23	CNG	100	6.31	35.45	370.24	485.74	7.51
24	Taxi Car	100	5.41	41.34	386.34	491.27	7.84
25	Bus	100	6.84	32.7	402.43	492.58	8.17
26	CNG	100	6.36	35.17	418.53	495.05	8.49
27	CNG	100	6.72	33.28	434.63	496.45	8.82
28	Bike	100	5.48	40.82	450.73	500.82	9.15
29	CNG	100	9.84	22.73	466.82	494.53	9.47
30	CNG	100	7.23	30.94	482.92	494.64	9.8
31	Car	100	5.92	37.79	499.02	497.64	10.13
32	Car	100	6.46	34.63	515.12	499.31	10.45

33	CNG	100	5.88	38.04	531.21	502.11	10.78
34	CNG	100	6.86	32.61	547.31	502.75	11.11
35	CNG	100	5.22	42.86	563.41	506.68	11.43
36	Bike	100	5.34	41.88	579.51	510.2	11.76
37	Bike	100	5.85	38.23	595.6	512.56	12.09
38	Car	100	6.39	35	611.7	513.78	12.41
39	Car	100	6.98	32.04	627.8	513.87	12.74
40	Bus	100	7.81	28.64	643.9	512.4	13.07
41	Car	100	6.57	34.04	660	513.21	13.39
42	Truck	100	7.92	28.24	676.09	511.64	13.72
43	Car	100	7.58	29.51	692.19	510.72	14.05
44	Car	100	7.92	28.24	708.29	509.29	14.37
45	Car	100	6.68	33.48	724.39	509.92	14.7
46	Bus	100	7.85	28.49	740.48	508.68	15.03
47	CNG	100	7.93	28.2	756.58	507.38	15.35
48	CNG	100	7.58	29.51	772.68	506.66	15.68
49	Car	100	6.52	34.31	788.78	507.51	16
50	Car	100	7.22	30.98	804.87	507.33	16.33
51	Car	100	6.08	36.79	820.97	508.76	16.66
52	Bike	100	6.12	36.54	837.07	510.08	16.99
53	Bike	100	5.86	38.17	853.17	511.72	17.31
54	Bike	100	6.24	35.84	869.26	512.79	17.64
55	CNG	100	7.83	28.56	885.36	511.72	17.97
56	Car	100	7.41	30.18	901.46	511.23	18.29
57	Bike	100	6.18	36.19	917.56	512.33	18.61
58	Bike	100	6.09	36.73	933.65	513.51	18.95
59	Car	100	6.22	35.96	949.75	514.5	19.27
60	Micro Bus	100	6.37	35.11	965.85	515.27	19.6
61	Truck	100	7.98	28.03	981.95	514.07	19.93
62	Bus	100	7.23	30.94	998.04	513.8	20.25
63	Car	100	6.54	34.2	1014.14	514.34	20.58
64	CNG	100	6.37	35.12	1030.24	515.07	20.91
65	CNG	100	5.98	37.4	1046.34	516.21	21.23
66	Car	100	5.72	39.1	1062.43	517.62	21.55
67	Bike	100	5.68	39.38	1078.53	519.04	21.89
68	Car	100	6.72	33.28	1094.63	519.28	22.21
69	Car	100	6.52	34.31	1110.73	519.73	22.54
70	Car	100	6.64	33.69	1126.82	520.04	22.87
71	Car	100	6.22	35.96	1142.92	520.78	23.19
72	CNG	100	6.77	33.07	1159.02	520.93	23.52
73	CNG	100	7.08	31.59	1175.12	520.76	23.85
74	CNG	100	6.94	32.23	1191.21	520.73	24.17
75	Bike	100	6.22	35.96	1207.31	521.43	24.5
76	Bike	100	5.92	37.78	1223.41	522.41	24.83

77	Bike	100	5.58	40.08	1239.51	523.7	25.15
78	Car	100	7.39	30.26	1255.6	523.2	25.48
79	Car	100	6.34	35.28	1271.7	523.72	25.81
80	Car	100	6.12	36.54	1287.8	524.44	26.13
81	CNG	100	7.11	31.46	1303.9	524.21	26.46
82	CNG	100	6.52	34.31	1320	524.53	26.79
83	CNG	100	6.67	33.54	1336.1	524.71	27.11
84	Bike	100	5.98	37.4	1352.2	525.51	27.44
85	Bike	100	6.04	37.03	1368.29	526.24	27.77
86	Bike	100	5.82	38.45	1384.39	527.16	28.09
87	Bus	100	8.14	27.47	1400.49	526	28.42
88	Bike	100	5.58	40.08	1416.59	527.1	28.75
89	CNG	100	7.89	28.35	1432.68	526.19	29.07
90	CNG	100	6.63	33.73	1448.78	526.37	29.4
91	Car	100	6.59	33.94	1464.88	526.58	29.73
92	CNG	100	6.72	33.28	1480.98	526.68	30.05
93	Bike	100	5.81	38.49	1497.07	527.53	30.38
94	Car	100	6.9	32.42	1513.17	527.46	30.71
95	Truck	100	8.32	26.88	1529.27	526.25	31.03
96	Bus	100	7.64	29.27	1545.37	525.61	31.36
97	Car	100	6.33	35.34	1561.46	526.02	31.67
98	CNG	100	6.65	33.63	1577.56	526.17	32.01
99	Car	100	6.7	33.39	1593.66	526.28	32.34
100	Bus	100	7.58	29.51	1609.76	525.72	32.67
			Total= 684.78				

4.6 Speed Density relationship for Kakrail to Moghbazar Route and Explanation of graph:

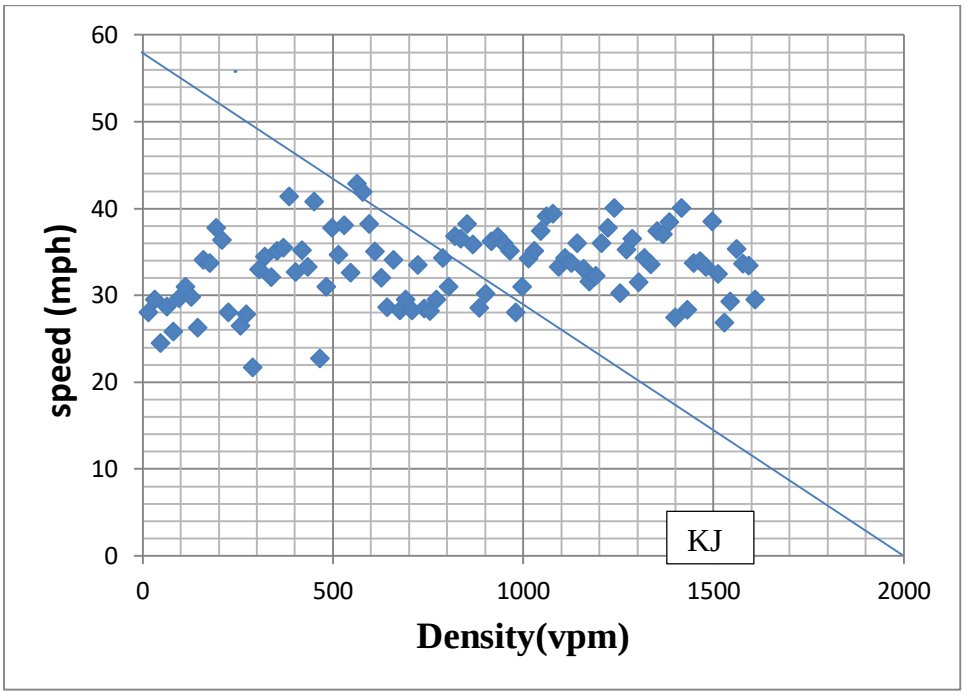

Figure: 4.6.1 Speed vs Density

- From Graph it's found that when the density is maximum then the speed is zero because of movement of vehicles are not possible on the road because of the space constrain.
- From graph it is found that maximum density 2000 vpm which is called jam density (KJ).
- From graph it is found that the maximum speed is 58 mph.

Relationship between Space Mean Speed and Flow for Kakrail to Moghbazar Route and explanation of graph:

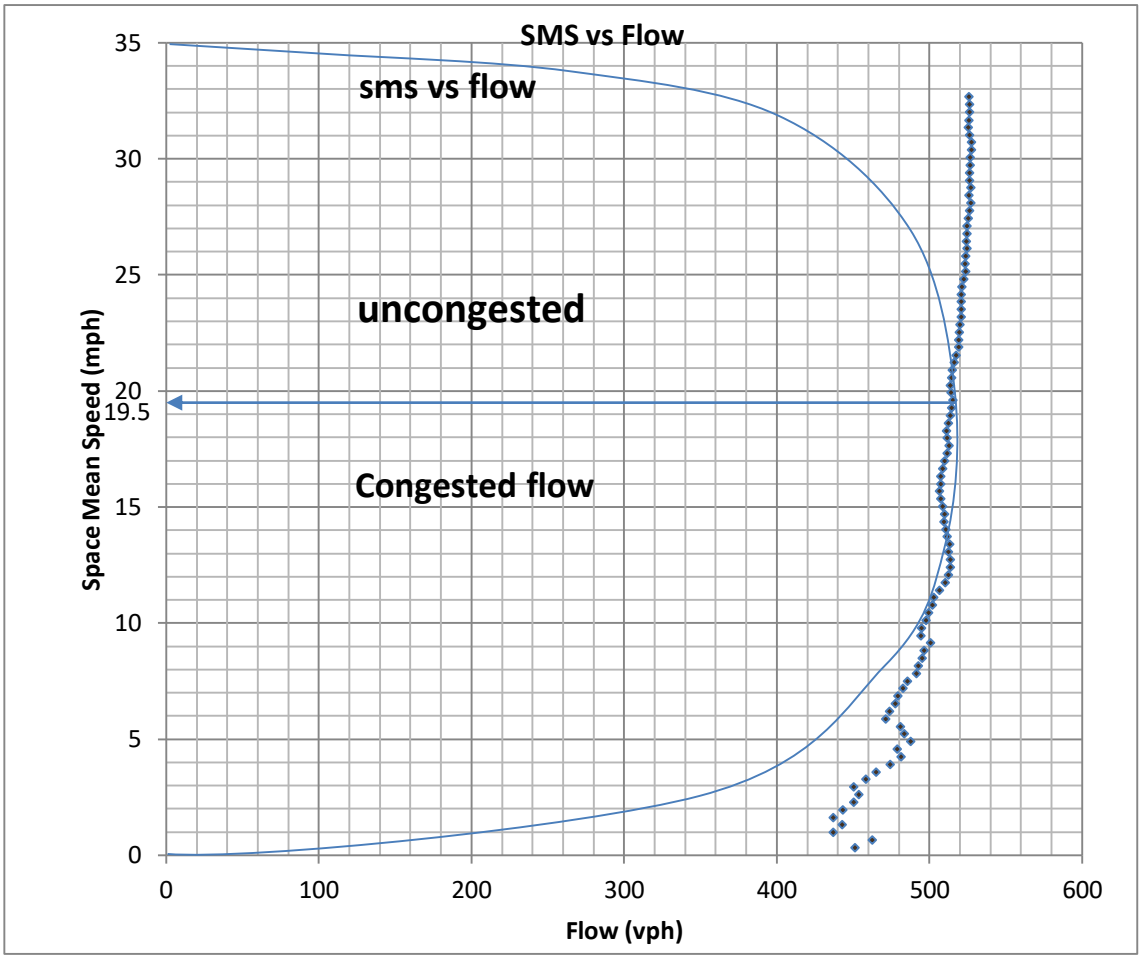

Figure 4.6.2: Space Mean Speed Vs Flow

- When the flow is zero then speed should be zero, on the other hand as the flow continues to increase then speed will be increase.
- From graph, at maximum speed of 19.5 mph the flow is uncongested.
- The maximum flow occurs at the speed 19.5 mph. At the speeds above this limit, flow is uncongested and below is congested.

Relationship between Flow vs Density for Kakrail to Moghbazar Route and explanation of graph:

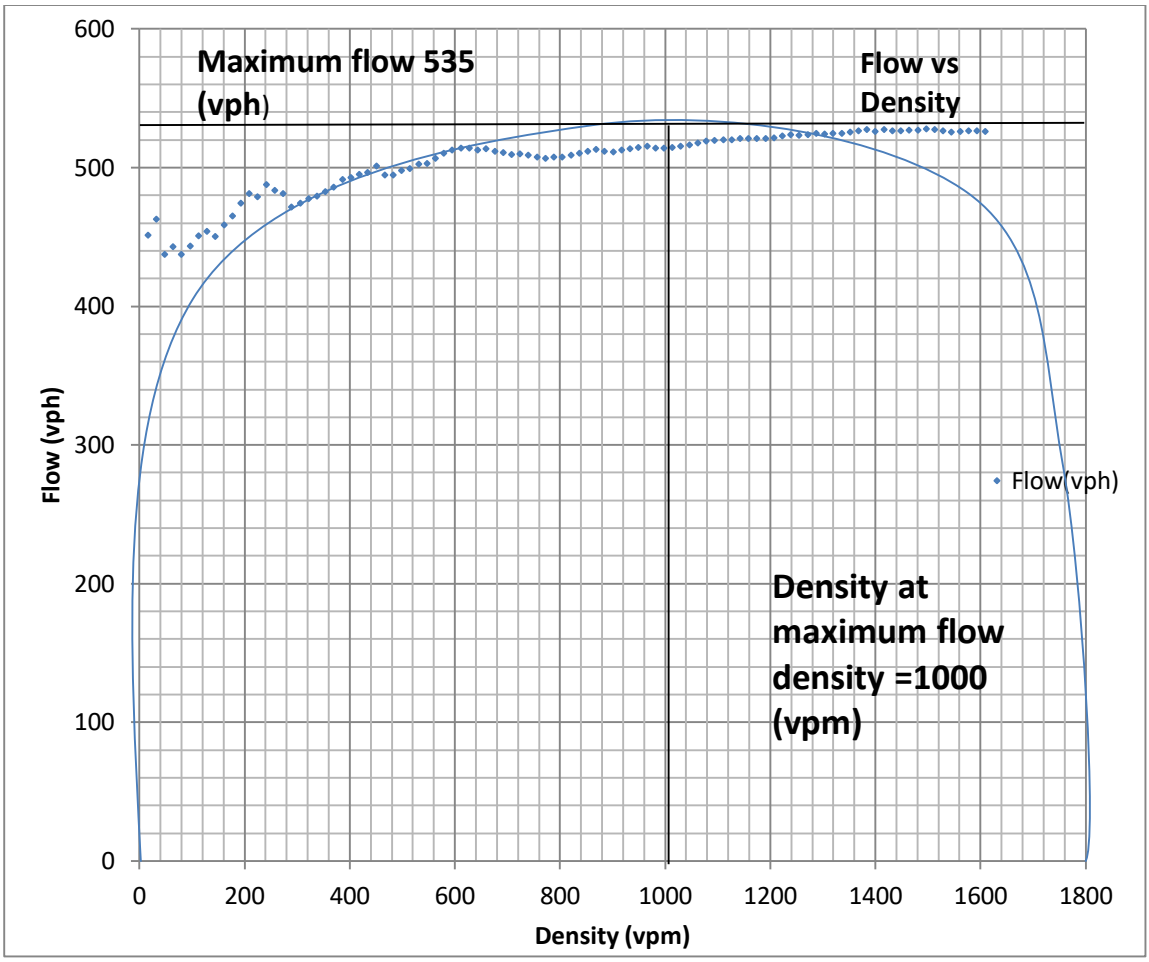

Figure: 4.6.3 Flow Vs Density

Time and location are the factors for the variation of flow and density. From the figure we can find the relation in between the flow and density and some of the characteristics are mentioned below.

- From graph we find the maximum flow 535 vph and at this time occurs density at maximum flow 1000 vpm and jam density (KJ) 1800 vpm which is called jam density.

- When there are no vehicles on the road then the density is zero and automatically the flow is zero.
- The density and flow will increase when the number of vehicles increases on the road.
- When the number of vehicle increases at its maximum then the vehicle's movement is quite impossible which is known as maximum density or jam density. The flow is zero at the position of jam density because vehicles are not moving.
- From the figure it is clear that the relation is in parabolic shape as shown in graph 4.6.3

Flow, Density, speed calculation for Moghbazar to Kakrail route in tabular form is given below where the total length were taken 100m by tape and time was taken 11.113 minutes SMS=(Space Mean Speed).

Table 2: Flow density calculation for Moghbazar to Kakrail route

Sl. No.	Vehicle name	Road Length(m)	Time(Sec)	speed(mph)	Density(vpm)	Flow(vph)	SMS(mph)
1	Car	100	7.21	31.03	16.09	499.31	0.34
2	Car	100	7.02	31.87	32.19	505.97	0.67
3	Car	100	7.83	28.57	48.29	489.57	1
4	CNG	100	8.34	26.82	64.39	473.68	1.34
5	CNG	100	7.93	28.21	80.48	469.61	1.68
6	CNG	100	7.58	29.51	96.58	470.49	2.01
7	Bike	100	6.18	36.2	112.68	483.78	2.34
8	Bike	100	6.38	35.06	128.78	492.56	2.68
9	Bike	100	5.93	37.72	144.87	503.11	3.01
10	Car	100	7.59	29.47	160.97	500.07	3.35
11	Truck	100	8.82	25.36	177.07	490.03	3.69
12	Car	100	5.86	38.17	193.17	498.44	4.02
13	Car	100	6.04	37.04	209.26	504.8	4.36
14	Car	100	5.93	37.72	225.36	510.95	4.7
15	CNG	100	6.27	35.68	241.46	514.73	5.03
16	Truck	100	5.8	38.57	257.56	520.28	5.37
17	Car	100	5.17	43.27	273.65	528.13	5.7
18	CNG	100	6.48	34.52	289.75	529.58	6.04
19	CNG	100	5.92	37.79	305.85	533.21	6.37
20	Micro Bus	100	4.38	51.07	321.95	542.74	6.71
21	Bus	100	6.17	36.26	338.04	544.55	7.04
22	Car	100	5.52	40.52	354.14	548.67	7.38
23	CNG	100	5.87	38.11	370.24	551.19	7.72
24	Car	100	5.98	37.41	386.34	553.14	8.05
25	Car	100	6.17	36.26	402.43	554.29	8.39
26	Bus	100	6.83	32.75	418.53	553.19	8.72
27	Micro Bus	100	5.72	39.11	434.63	555.68	9.06
28	Car	100	5.85	38.24	450.73	557.61	9.39
29	CNG	100	6.22	33.12	466.82	549.5	9.73

30	CNG	100	6.09	33.82	482.92	559.35	10.06
31	Bike	100	5.12	40.23	499.02	563.07	10.4
32	Bike	100	4.62	44.59	515.12	567.99	10.74
33	Car	100	6.32	32.59	531.21	568.04	11.07
34	Car	100	5.14	40.07	547.31	571.22	11.41
35	CNG	100	6.22	33.12	563.41	571.42	11.74
36	Car	100	5.51	37.38	579.51	573.43	12.08
37	Bike	100	4.48	45.98	595.6	577.9	12.41
38	Car	100	6.36	32.39	611.7	577.58	12.75
39	CNG	100	6.28	32.8	627.8	577.47	13.08
40	Car	100	6.22	33.12	643.9	577.5	13.42
41	Bike	100	4.12	50	660	582.32	13.75
42	Bus	100	6.72	30.65	676.09	581.11	14.09
43	Truck	100	6.36	32.39	692.19	580.75	14.43
44	Car	100	5.54	37.18	708.29	582.16	14.76
45	Bike	100	4.45	46.29	724.39	585.81	15.09
46	Car	100	6.32	32.59	740.48	585.45	15.43
47	CNG	100	6.87	29.98	756.58	583.99	15.78
48	Bike	100	5.28	39.01	772.68	585.74	16.1
49	Car	100	6.08	33.88	788.78	585.87	16.44
50	Car	100	6.22	33.12	804.87	585.73	16.77
51	Bike	100	5.35	38.5	820.97	587.22	17.11
52	Bike	100	5.4	38.15	837.07	588.57	17.44
53	Truck	100	7.89	26.11	853.17	585.37	17.78
54	Car	100	6.33	32.54	869.26	585.05	18.12
55	Car	100	6.41	32.13	885.36	584.61	18.45
56	Car	100	6.45	31.94	901.46	584.11	18.79
57	CNG	100	6.88	29.94	917.56	582.92	19.12
58	Bike	100	5.31	38.79	933.65	584.33	19.46
59	Bike	100	5.4	38.15	949.75	585.56	19.79
60	Car	100	6.35	32.44	965.85	585.23	20.13
61	CNG	100	6.82	30.2	981.95	584.2	20.46
62	CNG	100	6.86	30.03	998.04	583.13	20.8
63	Bike	100	5.42	38	1014.14	584.27	21.13
64	Taxi Car	100	6.73	30.61	1030.24	583.42	21.47
65	Bike	100	5.39	38.22	1046.34	584.56	21.81
66	CNG	100	6.71	30.7	1062.43	583.77	22.14
67	Car	100	7.35	28.03	1078.53	582.1	22.48
68	Police Car	100	7.56	27.25	1094.63	580.2	22.81
69	Car	100	7.31	28.18	1110.73	578.71	23.15
70	Bike	100	6.45	31.94	1126.82	578.41	23.48
71	Bus	100	8.85	23.28	1142.92	574.99	23.82
72	Bus	100	8.91	23.12	1159.02	571.63	24.15
73	Bike	100	6.35	32.44	1175.12	571.57	24.49
74	Bus	100	8.82	23.35	1191.21	568.49	24.83
75	CNG	100	7.75	26.58	1207.31	566.8	25.16
76	Bus	100	8.92	23.09	1223.41	563.8	25.5
77	Bus	100	8.95	23.01	1239.51	560.87	25.83
78	Car	100	7.41	27.8	1255.6	559.76	26.17
79	Ambulance	100	7.45	27.65	1271.7	558.64	26.5
80	Car	100	7.61	27.07	1287.8	557.38	26.84
81	Bus	100	8.86	23.25	1303.9	554.84	27.17
82	Bus	100	8.92	23.09	1320	552.31	27.51
83	Taxi Car	100	7.56	27.25	1336.1	551.25	27.84

84	Bus	100	8.93	23.07	1352.2	548.85	28.18
85	Car	100	7.48	27.54	1368.29	547.95	28.52
86	Bike	100	6.58	31.3	1384.39	547.94	28.85
87	Bike	100	6.46	31.89	1400.49	548.04	29.19
88	Bus	100	8.9	23.14	1416.59	545.84	29.52
89	Car	100	7.23	28.49	1432.68	545.25	29.86
90	Car	100	6.92	29.77	1448.78	544.96	30.19
91	Bus	100	8.39	24.55	1464.88	543.35	30.53
92	Micro Bus	100	6.15	33.49	1480.98	543.77	30.86
93	Bus	100	8.23	25.03	1497.07	542.35	31.2
94	Car	100	7.65	26.93	1513.17	541.47	31.53
95	Bus	100	7.87	26.17	1529.27	540.41	31.87
96	Bus	100	7.72	26.68	1545.37	539.54	32.2
97	Bike	100	5.34	38.57	1561.46	540.65	32.54
98	CNG	100	8.23	25.03	1577.56	539.35	32.88
99	Car	100	6.13	33.6	1593.66	539.8	33.21
100	Car	100	6.55	31.45	1609.76	539.89	33.55
			Total =666.8				

Speed Density relationship for Moghbazar to Kakrail Route and Explanation of graph:

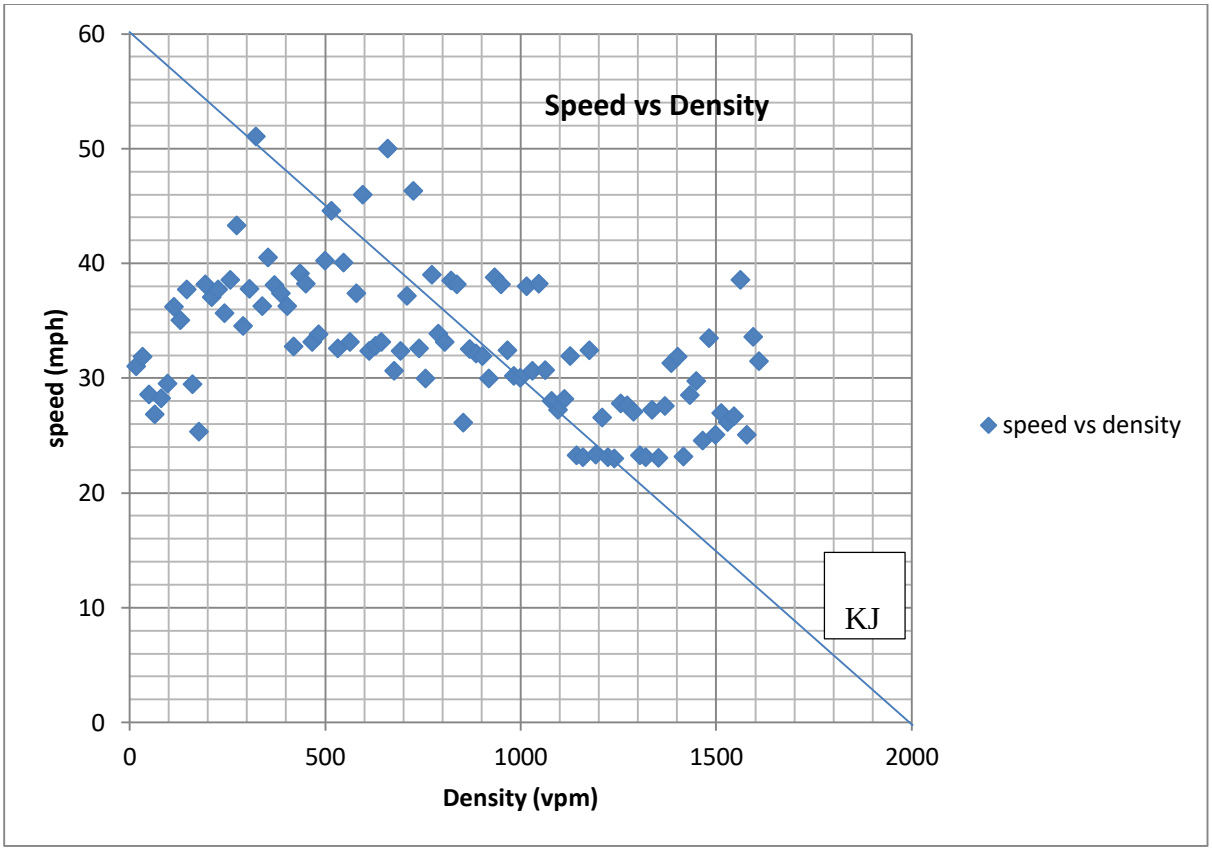

Figure: 4.6.4 Speed Vs Density

- From Graph it's found that when the density is maximum then the speed is zero because of movement of vehicles are not possible on the road because of the space constrain.
- From graph it is found that maximum density 2000 vpm which is called jam density (kJ).
- From graph it is found that the maximum speed is 60 mph.

Relationship between Space Mean Speed and Flow for Moghbazar to Kakrail Route and explanation of graph:

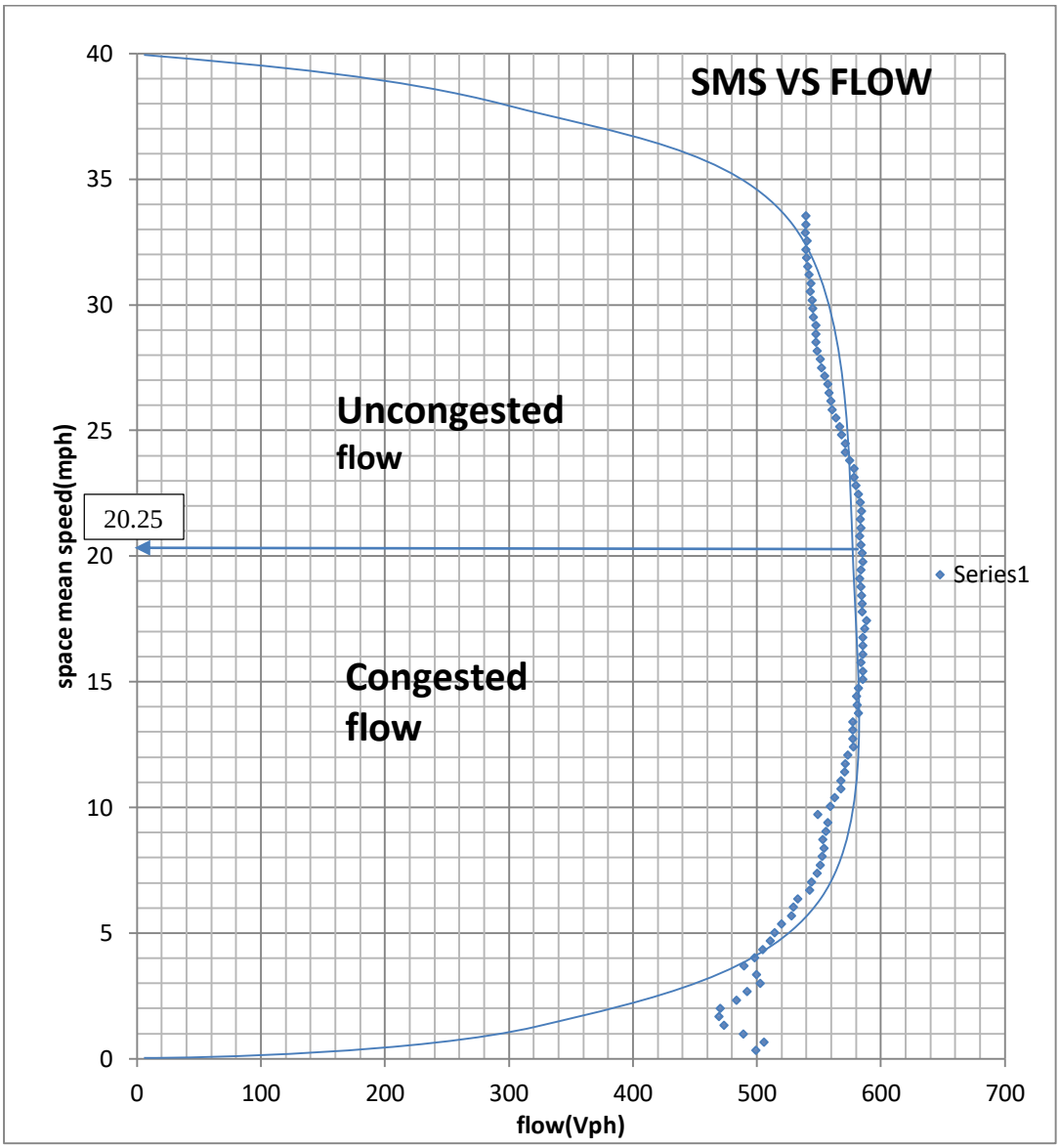

Figure 4.6.5 Space Mean Speed Vs Flow

- When the flow is zero then speed should be zero, on the other hand as the flow continues to increase then speed will be increase.
- From graph, at maximum speed of 40 mph the flow is uncongested.

- The maximum flow occurs at the speed 20.25 mph. At the speeds above this limit, flow is uncongested and below is congested.
- The flow become maximum when the speed is either zero or free flow speed.

Relationship between Flow Vs Density for Moghbazar to Kakrail Route and explanation of graph:

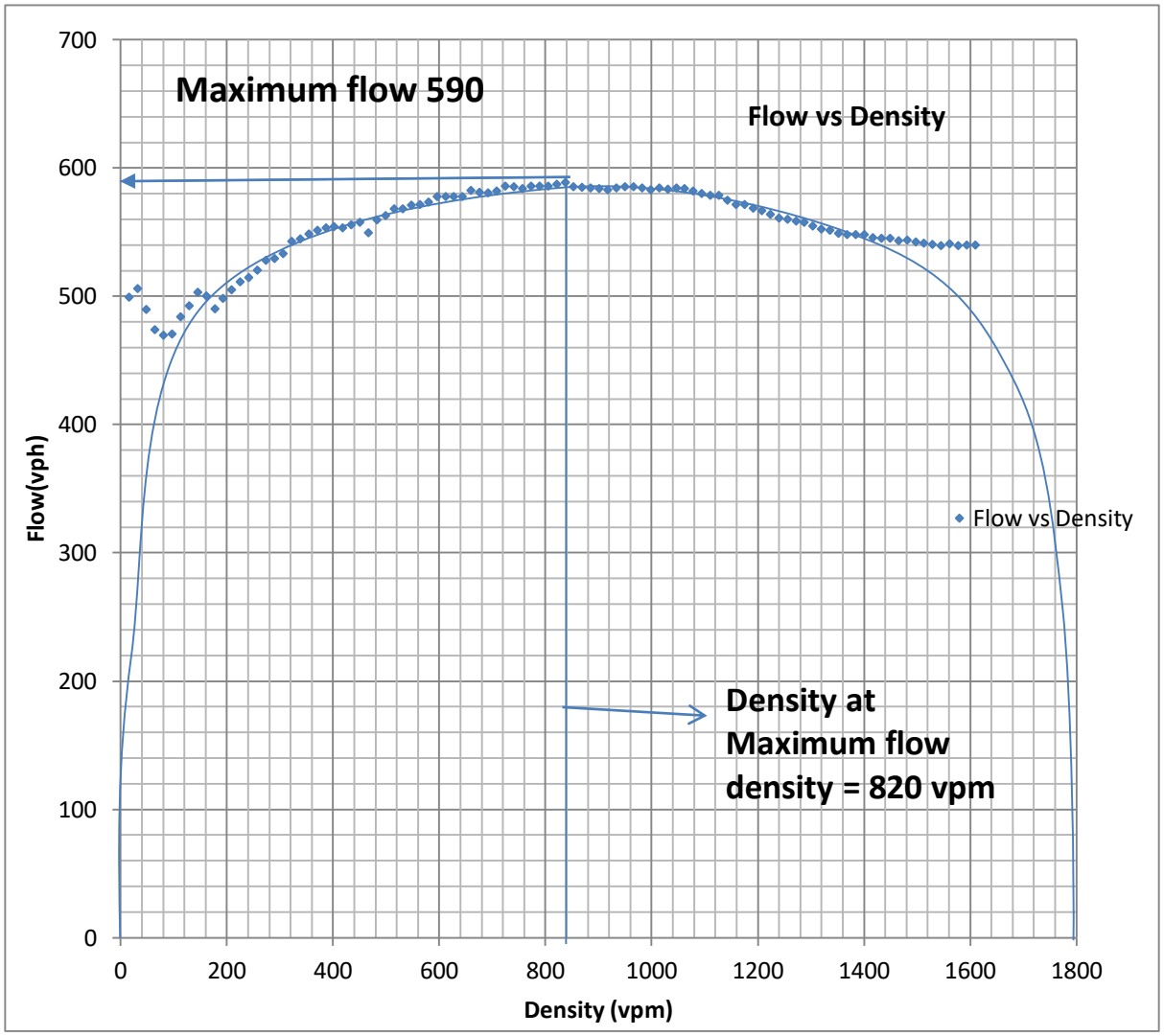

Figure 4.6.6: Flow vs Density

Time and location are the factors for the variation of flow and density. From the figure we can find the relation in between the flow and density and some of the characteristics are mentioned below.

- From graph we find the maximum flow 590 vph and at this time occurs density at maximum flow 820 vpm and jam density (KJ) 1800 vpm which is called jam density.
- When there are no vehicles on the road then the density is zero and automatically the flow is zero.
- The density and flow will increase when the number of vehicles increases on the road.

Speed-Flow-Density Relationship

Speed, flow, and density are all related to each other. The relationships between speed and density are not difficult to observe in the real world, while the effects of speed and density on flow are not quite as apparent.

Under uninterrupted flow conditions, speed, density, and flow are all related by the following equation:

$q = k*v$

Where
q = Flow (vehicles/hour)
v = Speed (miles/hour, kilometers/hour)
k = Density (vehicles/mile, vehicles/kilometer)

Because flow is the product of speed and density, the flow is equal to zero when one or both of these terms is zero. It is also possible to deduce that the flow is maximized at some critical combination of speed and density.

Two common traffic conditions illustrate these points. The first is the modern traffic jam, where traffic densities are very high and speeds are very low. This combination produces a very low flow. The second condition occurs when traffic densities are very low and drivers can obtain free flow speed without any undue stress caused by other vehicles on the roadway. The extremely low density compensates for the high speeds, and the resulting flow is very low.

4.7 Summary

The fundamental diagrams of traffic flow are vital tools which enables analysis of fundamental relationships. There are three diagrams - speed-density, speed-flow and flow-density. The chapter represents data collection, data analysis, flow density relationship for Kakrail to Moghbazar route (both direction) and explanation of value with graph both directions.

CHAPTER FIVE

CONCLUSIONS & RECOMMENDATIONS

CHAPTER V

CONCLUSIONS & RECOMMENDATIONS

5.1 General

This chapter will represent the conclusion of our study. A study on flow density relationship Kakrail to Moghbazar route (both direction) and also point out some recommendation that can be address in future studies.

5.2 Summary of Result

All the collection of the data are taken manually for flow density relationship Kakrail to Moghbazar route both direction at peak hour at 9am in morning and 5pm in afternoon because of the flow vehicle on the road is high and all the data analysis of Kakrail to Moghbazar route the value we can find for flow-density Figure 4.6.3 the maximum flow 535 vph and density 1800 vpm which is called jam density and density at maximum flow 1000 vpm, but at this same time opposites directions Moghbazar to Kakrail route Figure show 4.6.6 maximum flow 590 vph and density 1800 vpm which is called jam density and density at maximum flow 820 vpm. And the Figure 4.6.2 shown space means speed-flow and where maximum flow occurs at the speed 19.5 mph divided in two parts upper parts are uncongested flow and lower parts congested flow. Figure 4.6.1 shown speed-density relation when jam density 2000 vpm. Graph 4.6.4 shown speed vs density relation when jam density 2000 vpm. From Figure 4.6.5 (Space Mean Speed versus flow) it is found that the maximum flow occurs at the speed 20.25 mph.

Route	Maximum flow (vph)	Jam Density (vpm)	Density at maximum flow (vpm)	SMS (mph)	Speed Limit For Congested and uncongested flow (mph)
Kakrail to Moghbazar	535vph	2000vpm	1000vpm	35 mph	19.5mph
Moghbazar to Kakrail	590vph	2000vpm	820vpm	40 mph	20.25 mph

5.3 Conclusion

By conducting research on urban road the basic parameters of traffic flow have obtained. These parameters were used to develop diagrams for relations between flow, speed, and density in the un-congested regime. This made it possible to develop model equations, which can be used for theoretical determination of characteristics of the road in an urban road network in uncongested traffic conditions.

In this research the flow density relationship for Moghbazar to Kakrail and Kakrail to Moghbazar has been carried out. After that fundamental diagram for traffic flow for these routes have been prepared. For intersection area vehicles move slow and the traffic condition was not so good. And data collecting time are not same. Speed data was collected at different times for the reason speed value are so much difference. The Morning peak hour time the value of maximum flow occurs at the speed 19.5 mph & the evening peak hour time maximum flow occurs at the speed 20.25 mph.

5.4 Limitations

Have faced some problem for collecting data these are given below.

- It was too sunny weather
- During study there was a huge traffic jam in study area.
- Traffic police are not co-operative in many cases.
- Speed gun did not used in study time.
- Due to unrestricted movement of pedestrian, drivers often slow down speed of the vehicle so that we got irregular speed density and flow.

5.5 Recommendation

For further improvement of the study the following recommendations may be considered.

- Capacity volume data change also be done by the given data.

- We have calculated flow density and speed relationship for all types of vehicle but can also find specific vehicle flow-density and speed such as car, CNG, motorcycle, bus, truck, ambulance etc.

- From here we got flow density and speed analysis from Moghbazar to Kakrail route in both-directions and it can be done on the highway.

- Weather is a vital factor for collecting data, so a good sunny day should be selected for field survey.

- For approximate speed data speed gun can be used for getting spot speed.

- While use road crossing pedestrian need to be used zebra crossing in due time and avoid interrupted flow density and speed.

- Traffic rules and regulation should be followed by all.

5.6 Summary

This chapter represents and discusses about study conclusion and showed the limitation of work what we faced our study place and recommendation some point which will help future work.

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