COMPARISON OF DYNAMIC PCUS UNDER HETEROGENEOUS TRAFFIC CONDITION ON URBAN ARTERIAL ROAD : A CASE STUDY ON AHMEDABAD CITY

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CERTIFICATE

It is certified that the work contained in this dissertation thesis entitled '***DETERMINATION OF DYNAMIC PCUS UNDER HETEROGENEOUS TRAFFIC CONDITION ON URBAN ROAD : A CASE STUDY ON AHMEDABAD CITY"*** submitted by **MISS. SONI PRARTHNA PRAVINKUMAR**, **210041004** studying at Civil Engineering Department, Faculty of Engineering & Technology, for the award of M.Tech in Trasnportation Engineering is absolutely based on her own work carried out under my supervision and that this thesis has not been submitted elsewhere for any degree.

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Dedicated to,

For every success of my life, for being worm and caring, Great Enthusiasm, Inspiration, Support & Love are Heart of my Achievement.

Thank you.

My Mom, Dad &

My beloved Friends

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Place: Atmiya University, Rajkot **- Prarthna Soni**

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“Comparison of dynamic PCUs under heterogeneous traffic condition on Urban Arterial road : A case study on Ahmedabad city”

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ABSTRACT

The traffic stream in India behaves differently in a mixed traffic condition as compared to the western country mainly in the composition and lane discipline.Under such mixed traffic conditions, vehicles shows variation in their size and performance capabilities shares same lane on a road, which is highly heterogeneous in nature.The present study shows the concept of “Dynamic Passenger Car Unit (DPCU)” for the urban arterial road under heterogeneous traffic condition, and hence the Passenger Car Unit (PCU) does not remain static as it is assumed.Objective of the present study is to compare dynamic PCU values of different categories of vehicles at urban arterial road under mixed traffic condition by Homogenization coefficient method and Chandra’s method.The peak hour traffic was used to calculate the DPCU values and efforts were made to suggest the best reliable DPCU value.

Keywords: Heterogeneous traffic, Dynamic PCU, space mean speed, arterial road.

CHAPTER 1

INTRODUCTION

1.1 GENERAL INTRODUCTION

The heterogeneity in Indian road traffic is of high degree with vehicles of widely varying static and dynamic characteristics. Under such situation, it is difficult to make the vehicles to follow traffic lanes. In such condition, users tend to choose lanes according to the space availability and in result it creates the traffic congestion.

The different vehicle classes have a wide range of static and dynamic characteristics such as length, width, and so on. For analyzing traffic volume in such condition, PCU is the universally adopted concept for the measurement of traffic.

In other words, PCU is a measure of number of vehicles moving on a highway at a given point of time.The interaction between moving vehicles is influenced by a number of roadway and traffic factors.

This paper mainly focuses on the comparison of dynamic PCU values for different category of vehicles at mid-block section under mixed traffic conditions by adopting two different methods. Comparison of PCU values has been done and finally Chandra method can be suggested as a more reliable method to give realistic results.

1.2 PROBLEM IDENTIFICATION

- In static PCU, we consider the length of vehicles. Depending on the PCU value of passenger car, we assume PCU of all the vehicles with respect to length only.
- In dynamic PCU, we will consider the dynamic characteristics like speed of vehicles, length of vehicles, rectangular area of vehicles etc.

1.3 RESEARCH OBJECTIVE

The objective of work are,

- To determine dynamic PCU values for varying traffic composition at mid-block section in the stretch.
- To compare DPCU value by two different methods at Andhajan mandal road in Ahmedabad city .

1.4 SCOPE OF STUDY

- The scope of study is limited to mid-block section of road of urban arterial road.
- To estimate the traffic volume capacity of urban arterial road.

1.5 LIMITATIONS OF STUDY

- For various factors influencing the value of PCU, we will consider average speed of vehicle and average volume of traffic.
- The present study is limited to urban arterial road of Ahmedabad city only.

CHAPTER 2

INTRODUCTION TO PCU AND DPCU

2.1 General:

Traffic flow in India is generally heterogeneous in nature. However, the degree of heterogeneity varies with the circumstances. It is usually more developed in western countries in composition and lane discipline. Due to such heterogeneity, traffic studies often become difficult. Passenger Car Unit (PCU) is a universally adopted concept to convert the heterogeneous traffic volume into its equivalent homogeneous.

2.2 PCU(PASSENGER CAR UNIT)

Passenger Car Unit (PCU) is a vehicle unit or car unit is used to measure the rate of traffic flow or volume on highway.In other words, PCU is a measure of number of vehicles moving on a highway at a given point of time. In some instances, PCU is referred to as Passenger Car Equivalent (PCE).

To represent the entire traffic flow on a highway at a particular time, the flow of various classes of vehicles must be converted into a single standard vehicle type, such as Passenger Car. Therefore, passenger car unit (PCU) is allotted to each vehicle type.

Without converting the various vehicle classes into a single common standard vehicle unit, estimating the traffic flow of roadway facilities under mixed traffic condition is difficult.

PCU for different categories of vehicle largely varies depending upon the type of road facility.Estimation of PCU is important for each category of vehicle present in the traffic flow to design and analyse the performance of different traffic services and to manage the regulation and control of traffic.

The different class of vehicle have a broad range of static and dynamic properties, such as length, width, area and so on. As a result, mixed or heterogeneous traffic flow characteristics are far more complex than homogeneous traffic consisting only of passenger cars.

2.2.1 FACTORS AFFECTING PCU VALUE:

Several factors that affects the values of PCU of different type of vehicle are :

1. Dimensions of vehicle i.e. Length and width
2. Dynamic characteristics of the vehicle – speed, acceleration,power, breaking etc.
3. Environmental and Climatic conditions
4. Transverse and longitudinal gaps or clearance between moving vehicles depending upon the speeds, driver characteristics and the class of vehicle at the adjoining spaces.
5. Roadway characteristics such as gradient, curves, intersections,road geometrics, etc.
6. Traffic flow characteristics such as composition of different class of vehicles, mean speed and speed distribution of the mixed traffic flow and volume to capacity ratio.
7. Regulation and traffic control such as speed limit, one way traffic and different traffic control devices etc
8. There should be sufficient space available between the moving vehicles.

2.2.2 PCU VALUES FOR VEHICLE IN INDIA

In India, the present traffic condition are quite different compare to those present in the developed country.Thus the PCU of different class of vehicle do not remain constant in every region. PCU per hour per lane width or PCU per hour for the full roadway are mostly used to describe the capacity of various types of roadway facilities with mixed traffic flow, such as highways in rural areas and roads in urban areas.

For different types of fast and slow moving vehicles on rural roads, The Indian Road Congress (IRC) has proposed a range of PCU values in India for different types of vehicles on roads in rural areas.

Table 2.1 Recommended PCU factors for various types of vehicles on urban road(Website Source: Civil yard)

Sl. No.	Vehicle Class	Equivalency Factor	
		Percentage composition of vehicle type in traffic stream	
Fast Vehicles		**5%**	**10% & Above**
1	Two wheelers - motor cycle, scooter, etc.	0.5	0.8
2	Passenger car, Pick-up van	1.0	1.0
3	Auto-rickshaw	1.2	2.0
4	Light Commercial vehicle	1.4	2.0
5	Truck or Bus	2.2	3.7
6	Agricultural Tractor - trailor	4.0	5.0
Slow Vehicles			
7	Pedal cycle	0.4	0.5
8	Cycle rickshaw	1.5	2.0
9	Tonga (Horse drawn vehicle)	1.5	2.0
10	Hand cart	2.0	3.0

2.3 DPCU (DYNAMIC PASSENGER CAR UNIT)

2.3.1 CONCEPT OF DPCU

Due to inadequate handling and frequent congestion of traffic under fluctuating condition of traffic stream by different roadway facilities have been pointing towards some misconception developed for static PCU.

The PCU value of a specific vehicle currently may not be as consistent as we commonly believed. The PCU value of different class of vehicles is found to be fluctuating based on a

number of factors. As a result, the PCU of a certain class of vehicle is a dynamic changeable value that barely remains constant.

2.3.2 MODEL FORMULATION

The model formulation of dynamic PCU comprises of various influencing parameters discussed below. The parameters which are included are considered as most important are as follows:

- Composition of traffic flow i.e number of each vehicles categories in the stream.
- Total volume count of traffic handled by that particular road under mixed traffic conditions (Heterogeneous traffic) per unit time.
- Speed of each category of vehicle.
- Vehicle size (Rectangular area)

CHAPTER 3
LITERATURE REVIEW

3.1 GENERAL

In a long-form piece of written work, such as a dissertation or project, a literature review is mostly usually one of the first tasks carried out after deciding the topic. Reading combined with critical evaluation of the material can help to refine a topic and frame research questions.

3.2 LITERATURE REVIEW:

A literature review is a piece of writing written by an expert demonstrating their knowledge and understanding of the academic literature on a their specific topic placed in context. A literature review also includes a critical evaluation of the material as well as substantive finding; this is why it is called a literature review rather than a literature report.

Conducting a literature review establishes your knowledge and understanding of current research in a particular topic before carrying out a new investigation. After doing a literature review, you should know that what amount of research has already been done and be able to identify what is unknown within your topic.

When conducting and writing a literature review, it is a good practice to:

- To figure out and analyse previous research and theories.
- To analyze areas of controversy and claims have been made..
- Highlight any gaps in existing study that may exist in research to date.

3.3 RESEARCH WORK

A. MAHER, S. CHANDRA, S. VELMURUGAN (2014)

"Passenger Car Units at different Levels of Service for capacity analysis of multilane interurban highways in India."

Passenger car units (PCU) of different categories of vehicles are required to convert a mixed traffic stream into a homogeneous equivalent, and thereby to express the mixed traffic flow in terms of equivalent number of passenger cars. The present study provides values of PCU for different categories of vehicles typically found on interurban multilane highways in India at different levels of service (LOS). Traffic simulation model VISSIM was used to generate the traffic flow and the speed data for situations that are difficult to obtain from field observations. Important VISSIM parameters were first calibrated to reflect mixed flow of traffic behaviour and then the software is used to draw the speed-volume relationships for cars and one of the remaining four categories of vehicles in the traffic stream. The proportion of second category of the vehicle was also varied to observe its effects on PCU values. Finally, PCU values are suggested for different type of vehicles at different LOS and for different traffic composition on four-lane and six-lane divided highways.

Conclusion:

- They have studied on two section of interurban highways, one with four lane and other with six lane divided roadway.
- Traffic volume and speed data were collected for 6 hours during morning peak hours, non-peak hours and in evening hours by using video recording methods.
- They were used VISSIM model to know the effect of traffic composition on capacity and develop speed – flow curve for different combination of traffic composition
- The result obtained from study were value of PCU decrease with decrease in level of services from A to E.
- Capacity of four lanes and six lane divided highway was estimated as 4950 PCU/h and 6700 PCU/h in each direction of traffic movement.

Sheela Alex, Kuncheria P. Isaac (2015)

"Dynamic pcu values at Signalized intersections in India for mixed traffic."

This research paper highlights the methodology for developing the dynamic Passenger Car Unit (PCU) under different vehicular interactions for mixed traffic conditions similar in India. Several Experiments were performed using the micro simulation model, TRAFFICSIM, developed for signalized intersections by the authors elsewhere. The values of dynamic PCU were obtained based on the analysis of the outputs of TRAFFICISM, for varying approach traffic composition, width, stream speed and traffic volume. Modified area occupancy concept was utilized to develop Dynamic PCU values in a mixed traffic condition. In the modified area occupancy method, the area occupancy of the vehicle types for various traffic compositions is compared with area occupancy of the passenger cars in a car only traffic condition having the same stream speed. The study exhibit that the PCU values are highly sensitive to the given traffic conditions such as approach width, traffic composition, stream speed as well as flow ratio.

Conclusion:

- The value of dynamic PCU for all the types of vehicles have got a negative correlation with the stream speed except in the case of PCU of car and that of bus, in saturated condition.
- It was also observed that PCU values of two wheelers, three wheelers, car and bus decreases with increase in stream speed, during unsaturated stage.

GAURANG JOSHI, DINESH VAGADIA (2013)

"Dynamic Vehicle Equivalent Factors for characterisation of mixed traffic for multilane metropolitan arterials in India."

Traffic volume in our country which is key input for road system design is represented in terms of standard passenger car unit. As per IRC: 106-1990; Guidelines for Capacity of Urban Roads in Plain Area, recommends two sets of PCU values based on "5%" and "10% and more" composition of various vehicle types in total traffic volume. It is also established that the vehicle categories with major proportion in the traffic flow influence behaviour of other vehicles and therefore conversion of mixed traffic with predominance of two wheelers in to passenger cars is also in question. In this paper, Dynamic Vehicle Equivalent Factors (DVEF) namely Dynamic Car Unit (DCU) and Dynamic Two-wheeler Unit (DTU) are derived using modified homogenization coefficient approach based on extensive field traffic data collected by videographic technique on mid-block road sections of multi lane arterials in seven metropolitan cities of India. A simple method to derive traffic volume in DCU/DTU for different traffic composition and traffic volume for a standard 10.5 m wide three lane arterial road is discussed in the present study. Significance of DVEF and its variation with influencing parameters in mixed traffic is also discussed in this paper.

Conclusion:

- In this paper Dynamic vehicles equivalent factors (DVEF) called as Dynamic car unit and Dynamic Two wheeler unit (DTU) were derived by using homogenization coefficient approach.
- Traffic data is collected on seven cities of India, lucknow, Kanpur, Jaipur, Patna, Surat, Pune and Thiruvananthapuram.
- Traffic volume was counted manually for 1 min time interval and spot speed calculated by using stop watch.
- Mathematically, DVEF considering 'x' reference vehicles are the ratio of speed to area of vehicles.
- This study was based on real world observations and result may not exactly match simulation results.

MEGHA BHATT, PRIYESH PATEL (2017)

"Determination of Dynamic PCU in Ahmedabad city."

Due to rapid growth in population and vehicle ownership, there is tremendous traffic congestion on signalized intersections of urban corridors. If signalized intersections coming frequently on the corridor without coordination, then the vehicular delay is enormous during peak hours. Signal cycle timings were generally depend on the arrival rate and saturation flow rates of approaches. For the mixed traffic conditions, vehicles are converted into Passenger Car unit (PCU) to estimate the flow values. PCU values of different types of vehicles are varying with composition of vehicles, time, situation, location and their interaction. Static PCU values suggested by Indian Roads Congress (IRC) for the signalized intersection is generally overestimate the saturation flow rate. Dynamic PCU value for mid- block section in the Indian traffic scenario has been found by the several researchers, but very few researchers have attempted to find the dynamic PCU on the signalized intersections. This paper focuses on the estimation of dynamic PCU values for different categories of vehicles at signalized intersections under mixed traffic conditions by adopting directly proportional to the ratio of travel time of the vehicle, and inversely proportional to the space occupancy ratio of vehicle with respect to the standard area of vehicle, i.e. a car.

Conclusion:

In this paper, classify difference between static PCU value and dynamic PCU value. Data is collected with the help of videography at decided intersection during peak hours. They concluded that-

1. Mix and composite traffic observed during study.
2. At all intersection it is found that composite of two wheelers is quit high (60%-70%).
3. Three wheelers composite varies between (11%-19%).
4. Car composite varies between (14%-25%).
5. Light Commercial Vehicle composite varies between (0%-1%).
6. Bus composite varies between (0%-2%).
7. Non-motorized composite varies between (0%-2%).
8. Maximum vehicle are observed at Swastik Char Rasta intersection.
9. The proportion of 2W, 3W and Car is more as compared to LCV, Bus/Truck and NM.

Rudraksha S. Joshi, H.S.Goliya (2021)

"Capacity and Dynamic pcu estimation of urban roads for heterogeneous traffic: A case study in Indore city."

The present study focuses on estimation of passenger car unit of various categories of vehicles based on the dynamic properties of vehicles which is speed of the vehicle. Two six-lane divided roads are selected in Indore which are Vijay Nagar main road and AB road, survey work is carried out to find the speed of different categories of vehicle and the traffic volume. The PCU values of two wheeler and Three wheeler vehicle is found to be less than the IRC suggested PCU values while the PCU values of Bus, Truck and Big car is found to be high than the IRC suggested PCU values. The capacity of the selected six lane divided roads is found to be 3661 and 3380 PCU/hr. which is less than the IRC values because of high percentage of two wheeler vehicles in the traffic composition and very low PCU value computed as per their dynamic characteristic. A mathematical equation is developed to forecast the PCU for several vehicular categories that has been statistically validated by student t-test.

Conclusion:

The PCU values of Two-wheelers found by Speed-area method as well as generated model is found to be in range of .20 to .25 which is much lower than the IRC recommended value of .75, The IRC PCU values are 49..8% and 66.5% more for their composition respectively, PCU of TW vehicles needs to be adjusted for accurate capacity estimation

ER. SUMIT RANA, ER. ANIL KHARB (2016)

"Development of Passenger Car Units (PCU), case study of Ghantaghar chowk, Karnal district of Haryana."

The increase in traffic volume at our intersection has arise a problem like road accidents, conflicts and congestions. These problems can solve by providing an efficient traffic signal control at the intersection for continuous and efficient movement of vehicles through the intersection. According to traffic signal, signal timing is most important which is used to decide green time of the traffic light shall be provided at an intersection and how long the pedestrian walk signal should be provided. Traffic volume studies are to be made to determine the number, movement and classification of vehicles at the given location. These data is used identify normal flow of the road; determine the influence of heavy vehicles or pedestrians on vehicular traffic volume. The length of the sampling period depends on the type of count being taken. According to manual count with 15-minute intervals could be used to obtain the traffic volume data. The collected data is converted into PCU units. Webster's method is a rational approach for signal design. The design is simple and is totally based on formulae's laid down by Webster. In this method, the total cycle of the signal is determined which forms a total least delay occurring at signal.

Conclusion:

- They have collected speed measurement data, time headway measurement, width and lateral clearance in Karnal, Ghantaghar chowk, Haryana.
- Speed of different classes of vehicle was measured by speed gun software in a smart phone.
- They concluded that almost all classes of vehicles commonly found in Karnal city, India. The PCU value of each vehicle is not a constant but varies with several factors such as proportion of other classes, level of service, volume to capacity.
- The speeds of individual vehicles in the queue need not to be precisely equal, but may vary slightly from vehicle to vehicle and similarly the time headway of individual vehicles in the queue. In this study, the average value of speed and time headway is taken.

Barve Hitakshi , Sugandhi Sunil , Deulkar Vinay (2018)

"Estimation of capacity and PCU value for heterogeneous traffic stream."

In this paper the required data is collected at five main highways around and in Khandwa main highways around and in Khandwa City using a digital video recorder. This paper discussed the Capacity estimation of roa This paper discussed the Capacity estimation of roads and PCU value of a vehicle under ds and PCU value of a vehicle under heterogeneous traffic condition. In this pa In this paper the required data is collected at five main highways around and in Khandwa hways around and in Khandwa City using a digital video recorder. Detailed extraction of traffic volume and Detailed extraction of traffic volume and speed were made for every 5 minute time speed were made for every 5 minute time interval, covering both the peak and non interval, covering both the peak and non- peak period. Comparison of PCU values has been done and finally Cha parison of PCU values has been done and finally Chandra method is observed to give more reliable and realis method is observed to give more reliable and realistic results.

Conclusion:

It is observed that PCU values obtained for motor cycle, vehicle rickshaw, from all sections are smaller than the values given in IRC and for Truck, Trailer and L.C.V found better .

This observes has proven the impact of lane width at the PCU for different categories of vehicles and at the ability of two-lane Highways.

CHAPTER 4
STUDY AREA AND METHODOLOGY

4.1 GENERAL:

Study area is the important part of the research and it gives the effectiveness of the research area. Methodology for study depends on several parameters of vehicles like vehicle speed, vehicle types, road width, traffic composition, etc. These all data is collected by counting number of vehicles at particular location by using Classified Volume Count and average speed to determine Dynamic PCU under heterogeneous traffic condition.

4.2 STUDY AREA:

Ahmedabad is one of the most populous city in the Indian state of Gujarat.The current estimated population of Ahmedabad city in 2023 is 7,692,000 , while Ahmedabad metro population is estimated at 8,772,000 . The last census was conducted in 2011 and the schedule census for Ahmedabad city in 2021 was postponed due to Covid.

Ahmedabad is located at 23.03°N 72.58°E in western India at an elevation of 53 metres (174 ft) from mean sea level on the banks of the Sabarmati river, in north-central Gujarat. With semi arid climate, Ahmedabad's temperature varies from 15.40 c to 43.10 c annually. Annual rainfall of Ahmedabad is 782mm and humidity is 80%.

The Transit services in Ahmedabad are provided by Ahmedabad Municipal Transport Services (AMTS) and the Ahmedabad Janmarg Limited (AJL), and for regional public transit demand is catered by Gujarat State Road Transport Corporation (GSRTC). GSRTC is providing regional public transport services; this public transport service brings commuters from surrounding towns and villages such as Dehgam, Mansa, Khedbrahma and Gandhinagar.

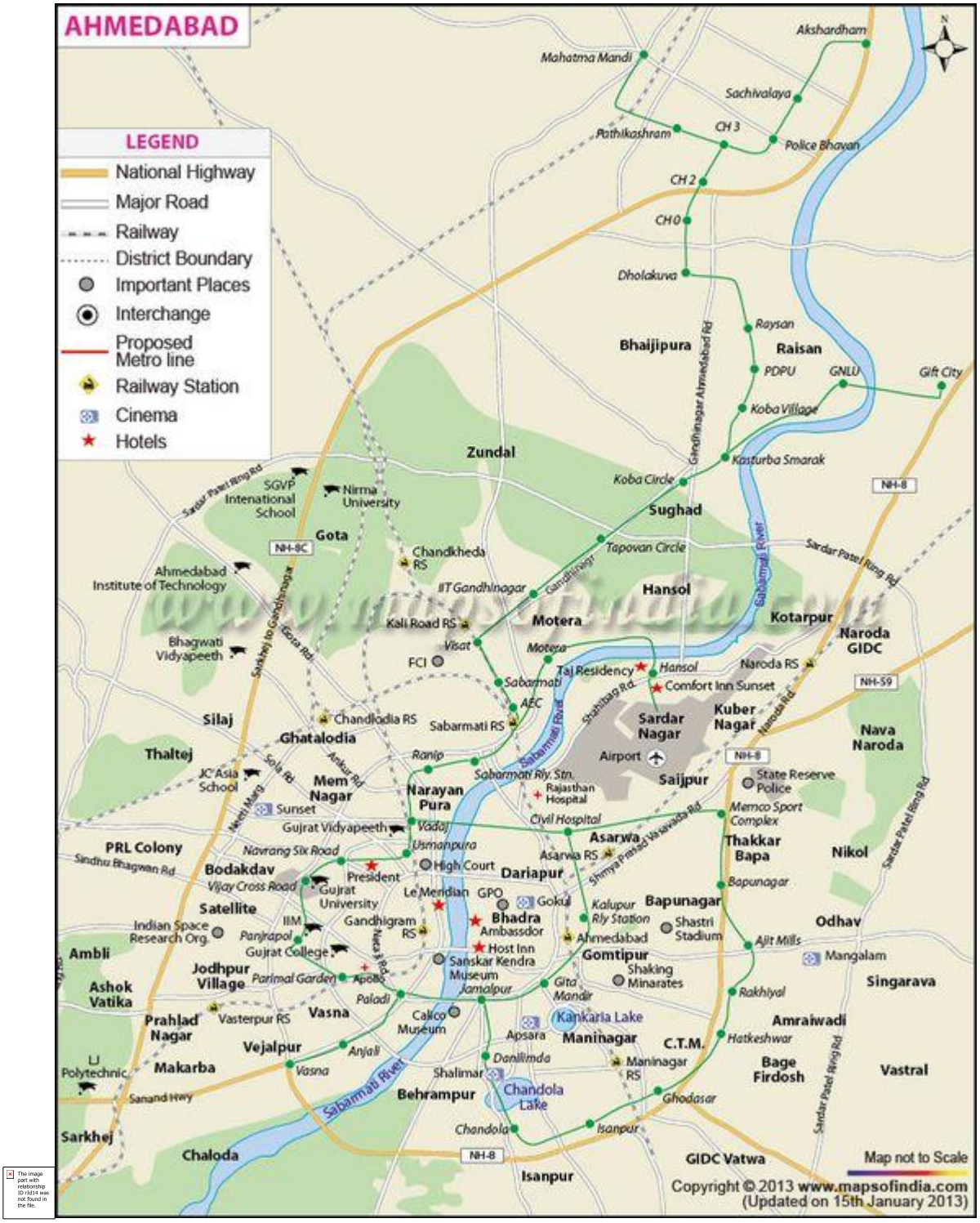

Figure 4.1 Map of Ahmedabad city (Source : Maps of India)

4.3 STUDY AREA CHARACTERISTICS:

I have selected one stretch of Ahmedabad city.

1. Andhajan mandal road

The present road have heterogeneous traffic condition and are two lane divided road.

On the road, 30m straight section selected and it should be free from effect of intersection, curvature, bus stop or any other side friction.

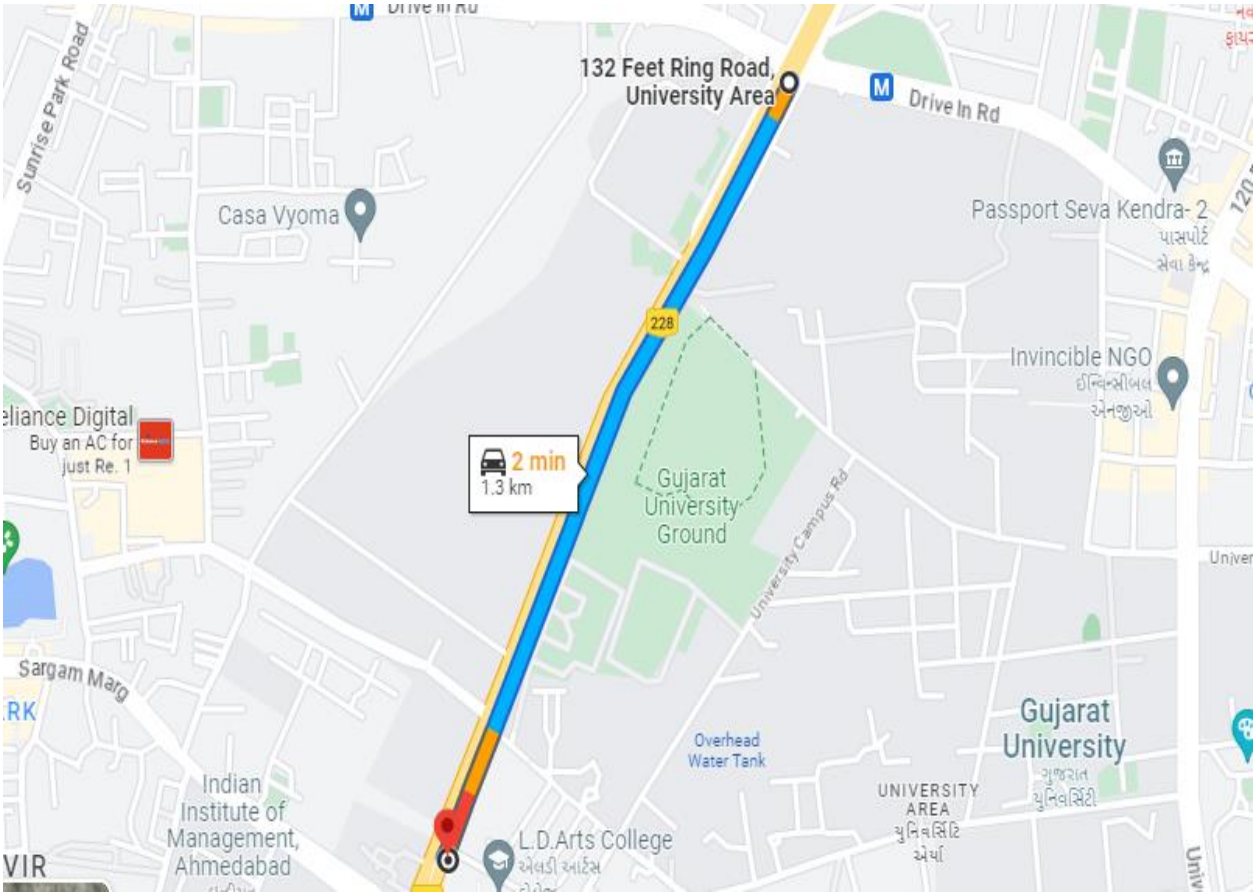

Figure 4.2 Map of Andhajan Mandal road (Source : Google Map)

Figure 4.3 Andhajan Mandal road

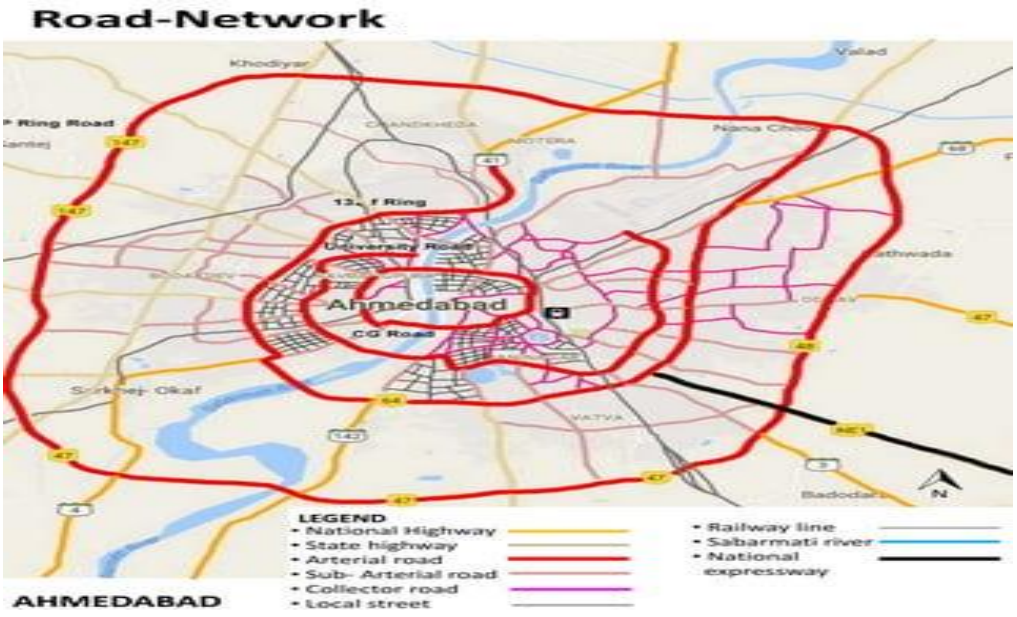

Figure 4.4 Road network of Ahmedabad

4.4 RESEARCH METHODOLOGY

4.4.1 Proposed methodology flow chart:

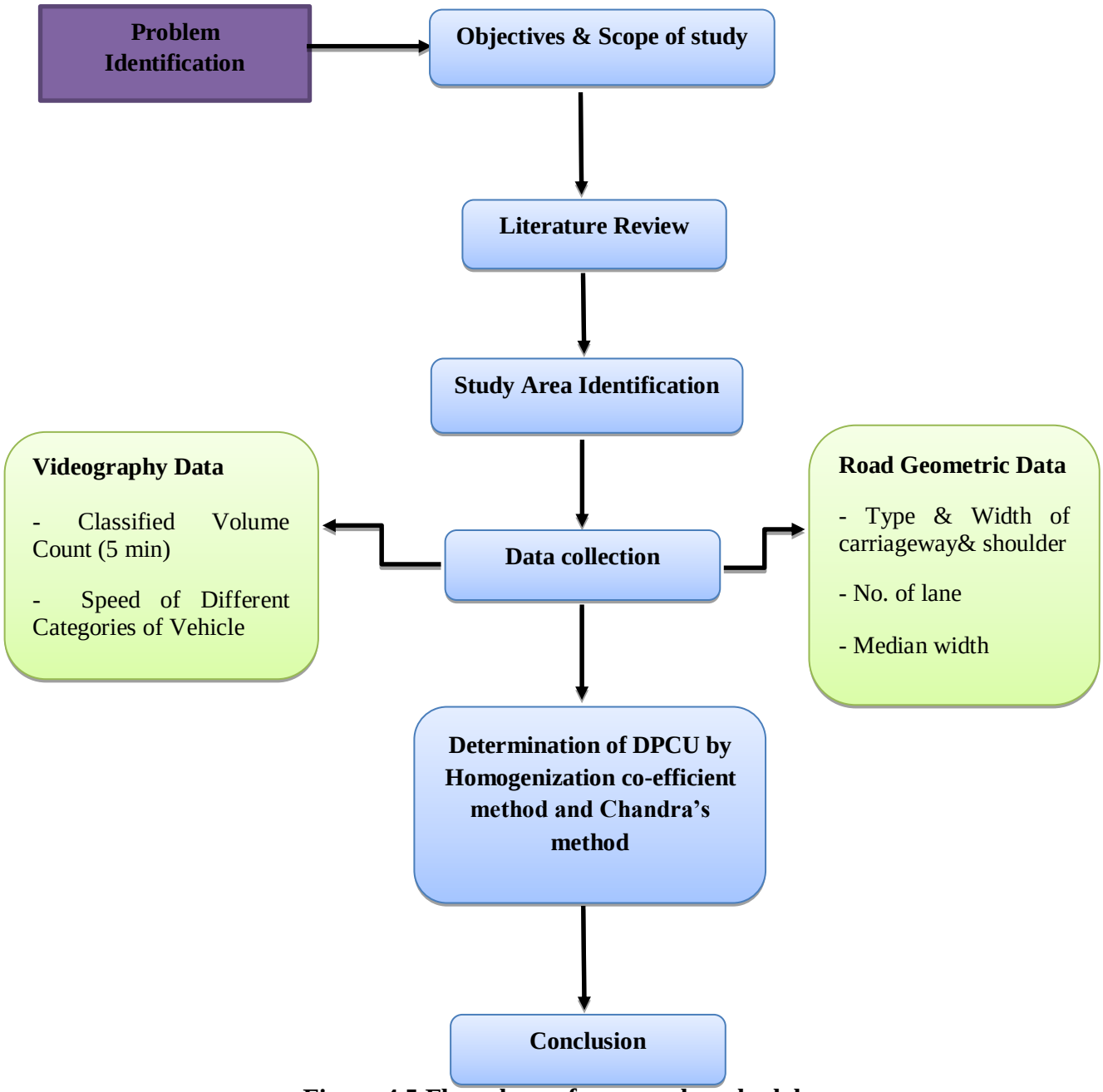

Figure 4.5 Flow chart of proposed methodology

4.5 Methods used for Data Collection:

4.5.1 Classified Volume Count:

To achieve the objectives in this thesis, field observation and data collection is required to measure the average speed of vehicle and volume of vehicle containing traffic flows of varied compositions. Data should be collected at mid-block section for classified volume count at 30m distance.

Type and width of carriageway, number of traffic lane, type and width of shoulder etc. geometric data collection are considered in this study. Depending on the present roadway condition,videography method were used for collection of traffic data for this thesis.Video camera have been places at the suitable location which can cover the traffic movement on selected stretch or road. Traffic data was collected in morning 8:00am to 11:00am and in evening 5:00pm to 8:00pm using videography method. Traffic counts were aggregated for a 5-minute interval.

4.5.2 Space Mean speed:

To determine the space mean speed of each category of vehicle, we have covered a 30m stretch , with the help of video. Where we can see how much time it takes for a vehicle to go through this stretch and from that we can find the average speed of the vehicle of each category. For example, it takes 5.6 second for a single vehicle to pass 30m stretch, then average speed of that vehicles:

Speed = distance / time

= 30 / 5.6

= 5.36 m/s

Therefore, speed of that vehicle is 5.36 m/s.

4.6 METHODS FOR DYNAMIC PCU AT MID-BLOCK SECTION OF URBAN ARTERIAL ROAD

The dynamic pcu of different vehicle can be derived by following methods:

1. Homogenization co-efficient method
2. Chandra's method
3. Headway method
4. Multiple regression method

The Method adopted in this thesis work to generate a model equation to calculate DPCU is Homogenization coefficient method which includes length & speed and Speed-Area method which is developed by Dr Satish Chandra

4.6.1 Homogenization Coefficient Method

In homogenization coefficient method, DPCU of a vehicle is obtained by comparing the theoretical maximum traffic capacity when different categories of vehicles are using the road. The method compares the "all car" and "all other than car type" capacity of traffic lanes.This method is mostly adopted by developed countries where homogeneous traffic conditions exist and lane discipline is followed. The DPCU value is determined by

$$PCU = Li/Vi \div Lc/Vc$$

Where,

L and V are the length and speed of a vehicle;

suffix i indicates a vehicle type and c indicates the car.

4.6.2 Satish Chandra's Method

This method is based on the concept of a speed and area characteristics of different class of vehicle.Along with the speed data of the vehicle, the projected rectangular area of vehicle is considered to determine the maximum theoretical capacity of the road to pass the vehicle.

The PCU value is determine by using following equation:

$$PCU = Vc/Vi \div Ac/Ai$$

Where,

V = speed of vehicle

A = area of vehicle

i = vehicle type

c = car

Table 4.1 Vehicle types and their dimension (Given: Indo HCM 2017, T-1.3)

Vehicle type	Length (m)	Width (m)	Projected area (sq. m)
Two wheeler	1.87	0.64	1.20
Three wheeler	3.20	1.40	4.48
Standard car	3.72	1.44	5.36
Big car	4.58	1.77	8.11
Bus	10.10	2.43	24.54
LCV	6.10	2.10	12.81
2/3 axle truck	7.50	2.35	17.63
MAT	12.10	2.44	29.52
Tractor	7.40	2.20	16.28
Cycle	1.90	0.45	0.86

4.7 SUMMARY:

This chapter includes study area characteristics and overview about the study area stretch. In this module, traffic flow and importance of heterogeneous traffic condition of this case study is discuss. Then flow chart of proposed methodology is shown through which gives the overview of the present thesis. Various methodology and various surveys have been discussed in this chapter. Both methods for data collection is also stated in this chapter.

CHAPTER 5
DATA COLLECTION AND ANALYSIS

5.1 GENERAL:

Data collection and analysis is the process of gathering, measuring, and analyzing accurate part of the thesis to accomplice the objectives with proper effectiveness. For estimation of Dynamic PCU, the required length of vehicle, rectagular area of vehicle and average speed of vehicle are collected to get the accurate outcome. Data analysis gives the idea about the traffic pattern, composition, space mean speed etc. of a particlar stretche.

5.2 DATA COLLECTION

From the videos different vehicles were tracked in mid-block section at Andhajan mandal road..The present road have heterogeneous traffic condition and are two lane divided road.On the road, 30m straight section selected and it should be free from effect of intersection, curvature, bus stop or any other side friction.

Video of flow of traffic on every road is taken (Tuesday and Sunday) to obtain a representation of traffic sample using the video camera. Peak data was collected in the morning at 8.00am to 11.00 am in the morning and O5.OOpm to 08.00pm in the evening for both the days.

5.2.1 Road geometric data

Roadway geometry include the following details of the existing facilities,

No. of carriageway
Carriageway width
Type of shoulder
Shoulder width
Type of pavement
Median width

Table 5.1 Road geometric data

Road characteritics	Andhajan mandal road
Type of carriageway	Three lane divided
Carriageway width	22.16m
Type of shoulder	Paved
Shoulder width	2m
Type of pavement	Bituminous
Median width	0.50m

Figure 5.1 To measure width of carriageway

Figure 5.2 Traffic volume count

5.2.2 Classified volume count data:

Andhajan mandal road:
Time: 8:00 to 11:00am, Date: 07/02/2023,

Time	2W	3W	Std. car up to 1400cc	Big car >1400cc	Bus	LCV up to 7 tonne	Tractor	Cycle
8:00 to 9:00 am	1877	254	1056	256	7	30	2	15
9:00 to 10:00 am	5713	357	1378	737	12	56	5	14
10:00 to 11:00 am	3529	435	1251	637	9	62	3	11

Table 5.2 Vehicle Composition at Andhajan Mandal road (Morning, Tuesday)

Vehicle composition :

Time: 8:00 to 11:00am, Date: 07/02/2023, Tuesday

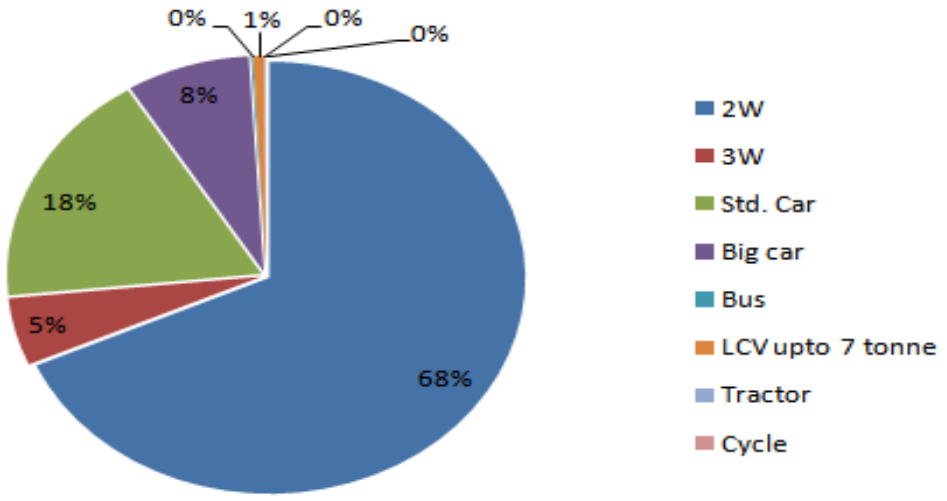

Figure 5.3 Vehicle Composition at Andhajan Mandal road (Morning, Tuesday)

Andhajan mandal road:

Time: 5:00 to 8:00pm, Date: Date: 07/02/2023, Tuesday

Time	2W	3W	Std. car up to 1400cc	Big car >1400cc	Bus	LCV up to 7 tonne	Tractor	Cycle
5:00 to 6:00 pm	2056	321	423	83	8	28	2	9
6:00 to 7:00 pm	3812	498	576	116	11	61	1	21
7:00 to 8:00 pm	913	679	1251	129	18	48	3	12

Table 5.3 Vehicle Composition at Andhajan Mandal road (Evening, Tuesday)

Vehicle composition :

Time: 5:00 to 8:00 pm, Date: 07/02/2023, Tuesday

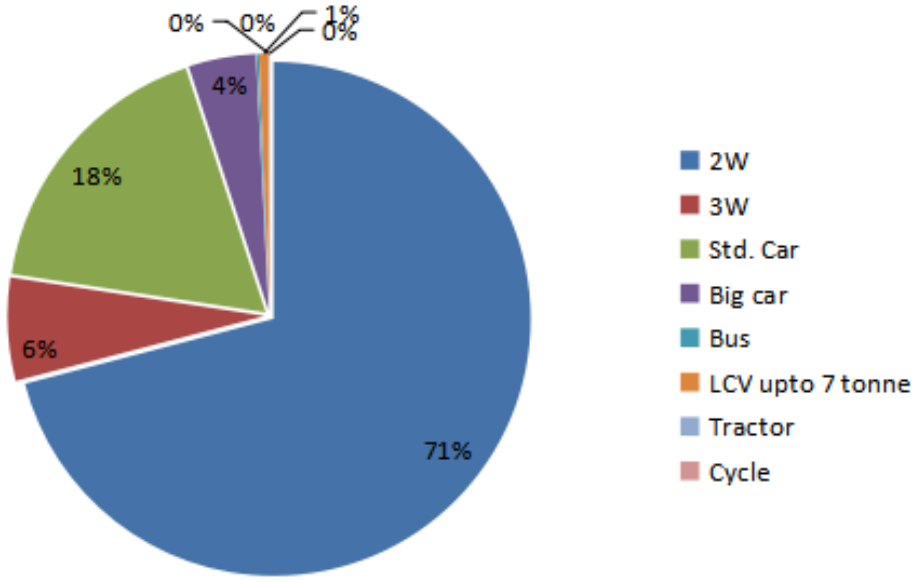

Figure 5.4 Vehicle Composition at Andhajan Mandal road (Morning, Tuesday)

Andhajan mandal road:
Time: 8:00 to 11:00am, Date: 12/02/2023, Sunday

Time	2W	3W	Std. car up to 1400cc	Big car >1400cc	Bus	LCV up to 7 tonne	Tractor	Cycle
8:00 to 9:00 am	2417	212	403	116	21	61	1	9
9:00 to 10:00 am	2787	241	541	98	39	82	0	4
10:00 to 11:00 am	3547	280	649	139	51	94	3	7

Table 5.4 Vehicle Composition at Andhajan Mandal road (Morning, Sunday)

Vehicle composition :

Time: 8:00 to 11:00 am, Date: 12/02/2023, Sunday

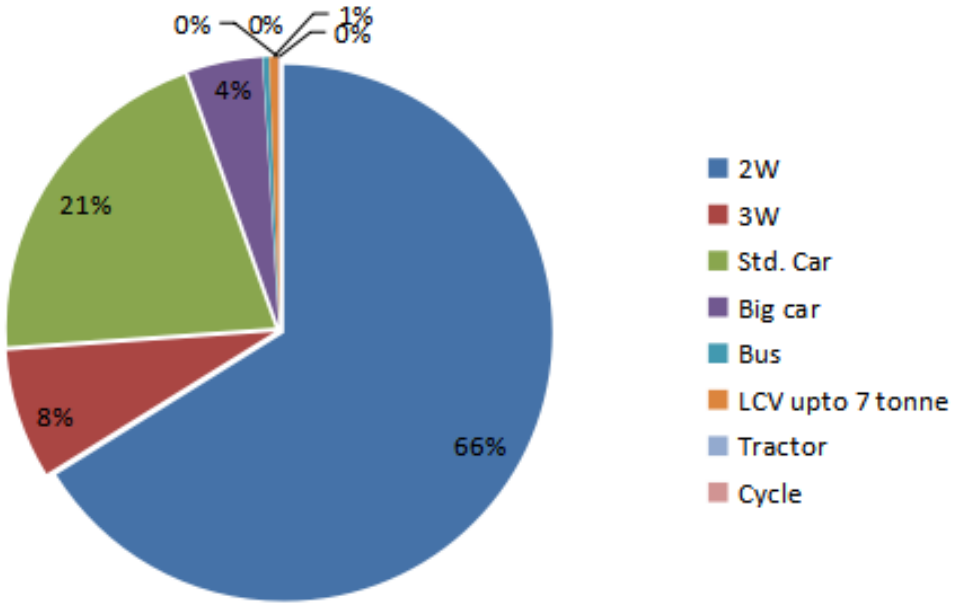

Figure 5.5 Vehicle Composition at Andhajan Mandal road(Morning, Sunday)

Andhajan mandal road:
Time: 5:00 to 8:00pm, Date: 12/02/2023, Sunday

Time	2W	3W	Std. car up to 1400cc	Big car >1400cc	Bus	LCV up to 7 tonne	Tractor	Cycle
5:00 to 6:00 pm	2987	337	433	104	23	29	0	1
6:00 to 7:00 pm	3256	352	521	116	26	78	0	4
7:00 to 8:00 pm	4281	297	651	168	35	77	2	1

Table 5.5 Vehicle Composition at Andhajan Mandal road(Evening, Sunday)

Vehicle composition :

Time: 5:00 to 8:00pm, Date: 12/02/2023, Sunday

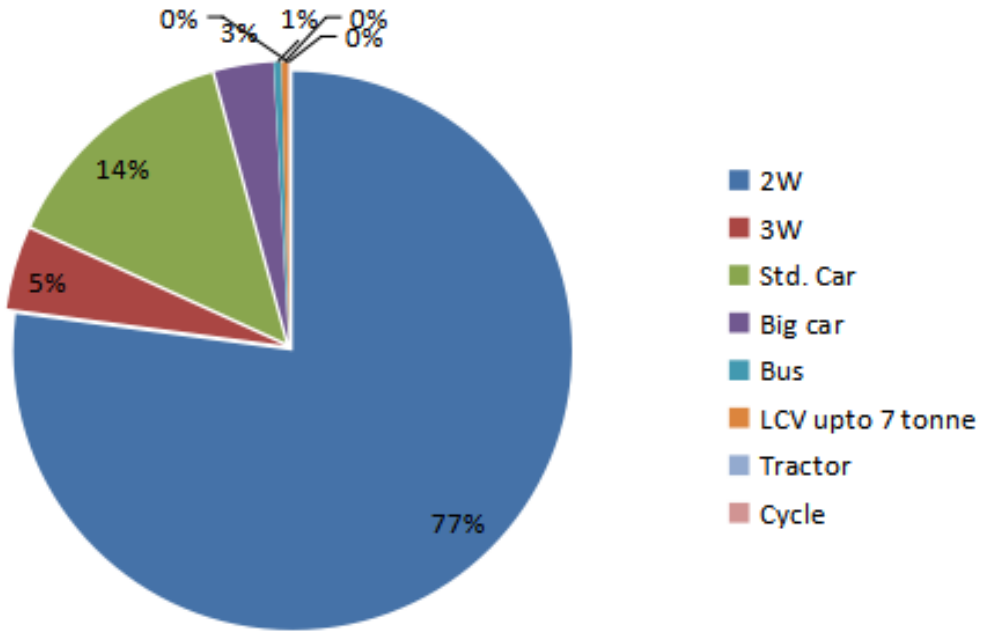

Figure 5.6 Vehicle Composition at Andhajan Mandal road(Evening, Sunday)

5.2.3 Average Space mean speed data:

Table 5.5: Speed statistics of individual vehicles

Vehicle type	Speed of the vehicle (m/s)
2W	**7.63**
3W	**6.89**
Std. car up to 1400cc	**5.66**
Bus	**17.83**
LCV	**8.91**
Tractor	**12.61**
Cycle	**3.63**

5.3 Summary:

In this chapter data collection & data analysis is presented in terms of pie chart and table for the Classified Volume Count of vehicle for data analysis and space mean speed analysis. This chapter is the important part of the research because the estimation of Dynamic PCUs is based on this data analysis.

CHAPTER 6
RESULT

6.1 General:

After data collection and data analysis, to find out the value of Dynamic Passenger Car Unit for all the Categories of vehicles like, two wheelers, three wheelers, standard car (up to 1400cc), big car (more than 1400cc), bus, light commercial vehicle (up to 9 tonne), tractor and cycle. Usually we use standard car as a passenger car to find out the dynamic PCU of vehicles. But here we are also using Big car as a passenger car to find the Dynamic PCU value of vehicles .

6.2 Result:

DPCU at Andhajan mandal road:-

Table 6.1 DPCU value at Andhajan mandal road

Types of vehicle	DPCU value			
	Homogenization coefficient method		Chandra's method	
	P.C. = Std. car	P.C. = Big car	P.C. = Std. car	P.C. = Big car
2W	0.350034	0.451381	0.200235	0.162438
3W	0.908471	0.913811	0.879112	0.138472
Std. car up to 1400cc	**1**	1.004341	**1**	0.820376
Big car >1400cc	1.024052	**1**	1.252546	**1**
Bus	4.685891	3.120518	4.527695	3.609435
LCV	2.326168	2.002990	2.137912	2.375381
Tractor	2.729912	1.363298	3.128739	4.297310
Cycle	0.251560	0.800792	0.323655	0.262743

CHAPTER 7

CONCLUSION

7.1 Conclusion:

The analysis is based on the field studies conducted on urban arterial road of Ahmedabad city considering almost all classes of vehicles commonly found in India.These results is shows the importance of increase the lane width in congested areas.Speeds of individual vehicles drops when it does not get sufficient space for vehicle movement.

Some of the major findings are described below,

- Mix and composite traffic observed during the traffic volume study.
- It is found that composite of two wheeler is quit high (60%-70%).
- Three wheelers composite varies between (7%-8%).
- Car composite varies between (21%-25%).
- Light Commercial Vehicle composite varies between (0%-3%).
- Bus composite varies between (0%-1%).
- The proportion of 2W,3W and Car is more as compared to LCV,Bus/Truck and Non motorized vehicle.

REFERENCES

JOURNAL ARTICLE

1. Barve Hitakshi , Sugandhi Sunil , Deulkar Vinay “Estimation of capacity and PCU value for heterogeneous traffic stream” Research Journal of Engineering Sciences Vol. 7(4)
2. Joshi, G. and Vagadia, D. (2013). “Dynamic vehicle equivalent factors for characterization of mixed traffic for multilane metropolitan arterials in India”,Journal of Indian Roads Congress, 74(2): 205-219.
3. Kishnani Madhuri, Prof. Juremalani Jayesh, Prof. N.B. Parmar “Development of Dynamic PCU value of vehicle at Padra Jambusar SH-160” International Journal of Scientific Research in Science, Engineering and Technology
4. Megha Bhatt , Priyesh Patel “Determination of Dynamic PCU in Ahmedabad city”International Journal of Advance Research and Innovative Ideas in Education,Vol-3 Issue-2 2017
5. Rudraksha S. Joshi, H.S.Goliya “capacity and dynamic pcu estimation of urban roads for heterogeneous traffic: a case study in indore city” International Research Journal of Engineering and Technology (IRJET) Volume: 08 Issue: 05
6. Sheela Alex, Kuncheria P. Isaac “dynamic pcu values at signalized intersections in India for mixed traffic” International Journal for Traffic and Transport Engineering (ijtte) 5(2):197-209
7. Safna Salam, Ayesha Shiraz,Muhammed Asifsha,Suhail A. Shahul,Shifana U. N “Determination of Dynamic PCU values at the signalized intersection for mixed traffic conditions” International Journal of Advance Research, Ideas and Innovations in Technology Volume 7, Issue 4 - V7I4-1250

IRC code:

8. IRC 106-1990 Guideline for capacity of urban road in plain area.
9. Indo-.HCM: 2017.

ANNEXURE 1

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College Code :

Branch Name : MTech Transportation

Theme of Title : Traffic

Title of Thesis : Determination of dynamic PCU under heterogeneous traffic condition on urban road : A case study on Ahmedabad city

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❖ **Comments For Internal Review (DP-1) (Semester 3)**

Exam Date : 30 / 11 / 2022

Sr. No.	Comments given by Internal review panel (Please write specific comments)	Modification done based on Comments
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2	Add literature review.	

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Particulars	Internal Review Panel	
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Institute :		Atmiya Uni.
Institute Code :		-
Mobile No. :		7874800084
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Particulars	Internal Guide Details	
	Expert 1	Expert 2
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Institute :	Atmiya Uni.	
Institute Code :	-	
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❖ **Comments of Dissertation Phase-1 ( )** **(Semester 3)**

Exam Date : 20 / 12 / 2022

Title :

1. Appropriateness of title with proposal. (Yes/ No) _____
2. Whether the selected theme is appropriate according to the title ? (Yes / No) _____
3. *Justify rational of proposed research.* (Yes/ No) _____
4. *Clarity of objectives.* (Yes/ No) _____

Suggested title

Comparison of DPCU under Heterogenous traffic condition of urban Arterial Road - A case study of Ahemdabad city.

20/12/2022

~3~

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- *Approved* ☐
- *Approved with suggested recommended changes* ☑
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2.	Provide Sources of Table & Statistics	
3.	References should be arrange Alphabetically	
4	As per Faculty of University guideline	
5.	Completion of work within due time frame.	
		Internal Guide Sign.

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- *Approved with suggested recommended changes* ☑
- *Not Approved* ☐

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ANNEXURE 4

Classified Volume Count data sheet

Andhajan Mandal Road								
Time: 8:00am to 11:00 am, Date:07/02/2023, Tuesday								
Time	**2W**	**3W**	**Std. car up to 1400cc**	**Big car >1400cc**	**Bus**	**LCV up to 9tonne**	**Tractor**	**Cycle**
8:00-8:05	211	25	76	42	1	1	2	1
8:05-8:10	242	**20**	81	35	1	3	0	2
8:10-8:15	258	15	85	32	1	4	0	4
8:15-8:20	235	20	92	39	0	2	0	2
8:20-8:25	276	21	98	46	2	6	0	1
8:25-8:30	236	26	104	41	1	1	1	5
8:30-8:35	302	27	101	35	1	7	0	
8:35-8:40	327	32	89	45	2	2		2
8:40-8:45	313	19	102	42	1	3		1
8:45-8:50	325	27	93	53	0	7	0	3
8:50-8:55	266	21	97	50	2	4	0	
8:55-	345	26	83	52	1	1	1	

9:00								
9:00-9:05	308	42	97	41	0	3		1
9:05-9:10	391	34	126	39	2	5	1	2
9:10-9:15	315	36	105	52	1	1		3
9:15-9:20	384	29	114	47	0	4		
9:20-9:25	365	39	112	51	1	9	0	
9:25-9:30	357	27	107	38	0	7	0	4
9:30-9:35	347	29	101	59	0	1	1	
9:35-9:40	381	19	106	50	1	4		2
9:40-9:45	374	42	121	61	1	5		
9:45-9:50	386	38	120	54	1	7		2
9:50-9:55	379	49	110	50	0	2		
9:55-10:00	364	46	114	49	0	5	1	1
10:00-10:05	325	41	119	45	2	7	0	2
10:05-10:10	352	37	101	50	0	2	1	
10:10-10:15	309	25	132	40	2	4		
10:15-10:20	356	32	102	58	0	2	0	

10:20-10:25	253	26	94	53	1	3	1	1
10:25-10:30	247	36	109	36	0	8	0	
10:30-10:35	285	31	100	38	1	8	1	
10:35-10:40	261	23	86	51	1	0	0	
10:40-10:45	243	29	115	18	0	7		1
10:45-10:50	271	18	105	36	0	8		
10:50-10:55	285	26	95	42	1	3		
10:55-11:00	245	13	93	40	0	2	0	
TOTAL	**11119**	**1046**	**3685**	**1630**	**28**	**148**	**10**	**40**

Andhajan Mandal Road								
Time: 5:00pm to 8:00pm, Date: 07/02/2023, Tuesday								
Time	**2W**	**3W**	**Std. car up to 1400cc**	**Big car >1400cc**	**Bus**	**LCV up to 9tonne**	**Tractor**	**Cycle**
5:00-5:05	151	21	32	9	0	3		
5:05-5:10	121	25	33	6	0	0		
5:10-5:15	101	37	33	9	0	1		1
5:15-5:20	124	28	39	7	0	2		1
5:20-5:25	162	36	30	12	0	3		
5:25-5:30	154	39	32	7	1	0		1
5:30-5:35	143	37	34	13	0	5		3
5:35-5:40	127	39	47	12	0	2		3
5:40-5:45	154	39	36	7	1	1	1	
5:45-5:50	123	31	39	15	0	1		4
5:50-5:55	174	46	42	9	0	2		1
5:55-6:00	138	43	49	7	0	5		
6:00-6:05	146	42	47	13	0	7		

6:05-6:10	138	43	54	9	1	6		2
6:10-6:15	187	42	51	11	2	5		
6:15-6:20	189	42	47	8	0	2		2
6:20-6:25	132	44	37	9	2	1		
6:25-6:30	192	45	59	12	0	3		
6:30-6:35	218	46	52	15	4	2		
6:35-6:40	257	47	42	9	0	4	2	
6:40-6:45	243	41	52	19	1	3		5
6:45-6:50	276	48	61	12	1	1		1
6:50-6:55	168	49	38	21	0	2	1	
6:55-7:00	182	21	42	13	0	4		
7:00-7:05	196	41	34	17	0	2		5
7:05-7:10	251	49	47	16	1	6		1
7:10-7:15	211	44	40	10	0	7		
7:15-7:20	216	52	41	11	1	6	1	1
7:20-7:25	155	50	51	12	4	3		1
7:25-	256	54	64	12	1	5		

7:30								
7:30-7:35	254	50	37	18	0	7		1
7:35-7:40	237	49	53	18	5	6		2
7:40-7:45	254	47	57	17	3	8		2
7:45-7:50	253	46	42	19	4	7	1	
7:50-7:55	251	43	49	28	0	8		3
7:55-8:00	247	42	52	29	5	7		2
TOTAL	6781	1498	1595	471	37	137	6	42

Andhajan Mandal Road								
Time: 8:00am to 11:00 am, Date:12/02/2023, Sunday								
Time	**2W**	**3W**	**Std. car up to 1400cc**	**Big car >1400cc**	**Bus**	**LCV up to 9tonne**	**Tractor**	**Cycle**
8:00-8:05	161	21	42	9	2	2		5
8:05-8:10	146	16	35	8	0	1		
8:10-8:15	106	12	37	12	5	1		1
8:15-8:20	152	16	31	6	2	4	1	
8:20-8:25	215	15	44	8	1	3	1	
8:25-8:30	236	22	39	7	7	2		
8:30-8:35	251	27	37	8	8	5		
8:35-8:40	221	21	32	9	6	11	1	1
8:40-8:45	184	12	34	12	1	3		
8:45-8:50	195	19	39	6	0	8		
8:50-8:55	281	17	33	11	2	3		
8:55-9:00	269	14	42	9	3	8		
9:00-9:05	225	22	35	11	0	7	1	
9:05-	257	24	34	13	1	12		2

9:10								
9:10-9:15	242	23	38	9	2	5		
9:15-9:20	221	6	39	15	0	10		
9:20-9:25	301	21	37	8	2	8		
9:25-9:30	224	28	32	10	0	3		2
9:30-9:35	287	25	47	11	4	13		
9:35-9:40	195	29	48	2	0	9		
9:40-9:45	162	9	39	3	1	8		1
9:45-9:50	203	16	46	2	1	7		
9:50-9:55	205	18	42	4	0	3	1	1
9:55-10:00	265	20	62	10	2	7		
10:00-10:05	224	32	56	16	7	9		1
10:05-10:10	258	29	54	7	9	6		
10:10-10:15	274	14	68	6	5	7	1	1
10:15-10:20	254	22	57	18	8	12		
10:20-10:25	312	32	55	7	4	4		1
10:25-10:30	332	21	49	12	1	8		

10:30-10:35	357	22	58	14	4	7	1	2
10:35-10:40	332	23	49	8	5	11		
10:40-10:45	318	18	62	9	3	8		
10:45-10:50	284	27	50	11	4	7		
10:50-10:55	274	21	47	12	6	8		1
10:55-11:00	328	19	44	19	5	7		
TOTAL	**8751**	**733**	**1593**	**342**	**111**	**237**	**7**	**19**

Andhajan Mandal Road								
Time: 5:00pm to 8:00pm, Date: 12/02/2023, Sunday								
Time	**2W**	**3W**	**Std. car up to 1400cc**	**Big car >1400cc**	**Bus**	**LCV up to 9tonne**	**Tractor**	**Cycle**
5:00-5:05	241	29	22	8	2	0		
5:05-5:10	263	22	18	8	2	2		
5:10-5:15	249	33	31	11	1	1		1
5:15-5:20	298	31	29	6	2	1		
5:20-5:25	178	33	48	13	2	4		
5:25-5:30	289	28	41	9	2	0		
5:30-5:35	278	24	49	8	2	2		1
5:35-5:40	219	21	28	10	3	5		
5:40-5:45	196	26	41	7	1	0		
5:45-5:50	281	32	42	6	2	3		
5:50-5:55	213	25	39	13	3	8		
5:55-6:00	282	33	45	5	1	3		
6:00-6:05	304	27	42	4	4	8		
6:05-	206	32	47	8	2	7		

6:10								
6:10-6:15	318	29	39	7	1	9		
6:15-6:20	321	21	44	6	2	5		
6:20-6:25	319	33	45	13	2	7	1	
6:25-6:30	259	41	49	8	1	8		
6:30-6:35	289	29	38	12	2	3		1
6:35-6:40	311	31	42	8	2	4		
6:40-6:45	227	26	43	5	4	9		
6:45-6:50	225	30	51	13	2	8		
6:50-6:55	232	31	39	18	1	7		
6:55-7:00	245	22	42	14	3	3		
7:00-7:05	334	27	46	9	2	7		1
7:05-7:10	332	31	45	15	4	9		
7:10-7:15	349	23	51	19	5	7		
7:15-7:20	321	29	58	16	2	2		
7:20-7:25	340	22	54	16	3	4		
7:25-7:30	363	28	49	9	2	8		

7:30-7:35	331	23	51	14	2	7	1	
7:35-7:40	337	28	63	11	3	3		
7:40-7:45	364	25	55	12	5	8		1
7:45-7:50	441	21	65	12	2	7		
7:50-7:55	331	23	51	19	4	8		1
7:55-8:00	438	17	63	16	1	7		
TOTAL	**10524**	**986**	**1605**	**388**	**84**	**184**	**2**	**6**