PLANNING FOR PEDESTRIAN SAFETY ON JUNCTION: A CASE OF AHMEDABAD

Thesis submitted in
Partial Fulfilment for
the Award of the Degree of

Master of Urban and Regional Planning

by

Meet Rakeshbhai Patel
Second Semester, MURP II – 2020-21

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Secondary Guide: Ms. KHYATI G TEWARI

Master of Urban and Regional Planning (MURP) Program
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CERTIFICATE

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The contents presented in this Thesis represent my original work and it has not been submitted for the award of any other Degree or Diploma anywhere else.

Meet Rakeshbhai Patel

This Thesis is submitted in partial fulfilment of the requirements for the Degree of Master of Urban and Regional Planning
at the Department of Architecture
Faculty of Technology and Engineering
The Maharaja Sayajirao University, Vadodara, Gujarat, India
The present work has been carried out under our supervision and guidance and it meets the standard for awarding the above stated degree.

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Abstract

In today's world pedestrian safety is one of the major concerns. Increase in population has led to globalization and thus the focus towards pedestrian safety has been decreased with increase in use of vehicles in the transport system. Though footpaths, foot over bridge and other developments are done in Ahmedabad city but very less research has been done for the factors such as road environments, traffic factor in fatal pedestrian crashes and many more. In this study, the major road accident junctions of Ahmedabad were chosen. Two different multiple junctions were selected for the survey. Based on survey, various issues such as excessive peak hour traffic, Blind spots over the bridge, Bottlenecks due to narrow bridge, High speed, traffic Poor Road marking and signage, Conflicts while crossing as well as along the highway, were identified. All these issues were identified through video observation, data analysis and simulation through VISSIM software. The PCU was analysed, and simulation helped to find the points of crash at certain junctions. Results showed that there were various risk factors which affected the pedestrian and redesigning of this junction has been done. Beside this the data was also collected from the AMC which has been used in this research.

This thesis is dedicated to my parents,

Mrs. Daxa Patel and Mr. Rakesh Patel,

For their constant support and encouragement.

Acknowledgements

First and foremost, I would like to thank God, with whose blessings I have finally completed my thesis.

I am extremely grateful to my thesis guides, Ms. Hiral Shah and Ms. Khyati G Tewari, for their valuable time, support, and guidance. I would also like to express my gratitude towards the head of the department, Dr. Bhawana Vasudeva and all the faculties and staff of the department. I thank them all for the extensive amount of time and effort they have spared for me. This would not have been possible without your help.

I wish to express my heartiest regards to my parents and my teachers for their guidance and moral support.

I would also like to thank government officers as well as on site traffic police officers for their selfless support and giving permission to complete my thesis.

Last but not the least, my sincere thanks to all my friends who have patiently extended all sorts of help and motivated for accomplishing this undertaking.

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CHAPTER-1 INTRODUCTION

1.1BACKGROUND

People walk for many reasons: to go to a neighbour's house, to run errands, for school, or to get to a business meeting. People also walk for recreation and health benefits or for the enjoyment of being outside. Some pedestrians must walk to transit or other destinations if they wish to travel independently. It is a public responsibility to provide a safe, secure, and comfortable system for all people who walk. There are many problems related to safety security of pedestrians.

Pedestrian Problems

- Overcrowding along narrow footpaths
- Footpaths occupied by pavement dwellers or informal sellers.
- Absence of footpaths/walkways
- Difficulties in crossing the road at ground level.
- Poor signage, and barriers to pedestrian movement
- An unwelcoming environment for the elderly and physically disabled.
- Safety problems in relation to traffic and in areas that are poorly lit or badly maintained.
- Noise and air pollution from traffic
- Unattractive streets and pedestrian links which lack character, identity, and comfort (shade, seating, plants etc.)

According to the statistic one third of the accidents are related to pedestrians. In India, during 2017 1.47lakh people get killed in road crash beside this according to the reports of Times of India more than 56 pedestrian are killed daily due to road accidents.

Government data shows the number of fatalities shooting up from 12,330 in 2014 to 20,457 in 2017- a jump of nearly 66%. That is the reason

pedestrian safety emerges as a major challenge for transport planner's and traffic engineers. From last few years there is rapid increase in travel demand particular automobiles as well as walking (in most of Indian cities) and to convey the demand whatever neglected.

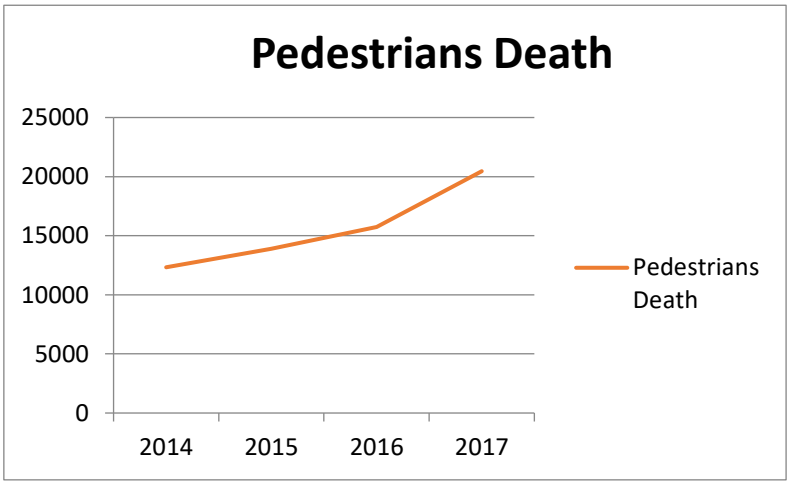


FIGURE 1.1 PEDESTRIAN DEATH

In Indian cities a large proportion of travel demand is conducted by walking. However, in all Indian cities there is no focus on pedestrian and pedestrian base infrastructure. Pedestrian safety is the almost untouched topic. Consequently, pedestrian are the major victims of road accidents. The major accidents happen along the junction of the cities where vehicular traffic interacts with pedestrians. Hence pedestrian safety as well as vehicular safety is challenge for urban planners, Engineers, Urban designers, Urban local bodies, and policy maker to make our cities safer.

1.2 DEFINING 'PEDESTRIANS'.

Hodgson et al. (2004) say that the pedestrian is not to be treated as a homogenous group. There are different types of pedestrians, and they have different requirements when it comes to walking conducive pedestrian facility. And thus, pedestrian facility should be inclusive towards abled and disabled alike - the pedestrian infrastructure should also have provisions

for people using wheelchairs, for mothers walking with prams and even elderly and children.

1.3 NEED FOR STUDY

The road network is the skeleton of the cities. Links and nodes compose the whole road layout of the town. As the town becomes more and more populated the road networks of the town expands. The road user category also varied from low speed to high-speed vehicles. Whole traffic (mixed traffic in Indian scenario) of the society interacts the node of the road layout. Junctions are the place where motorised ad non-motorized (pedestrian) vehicle interacts during throughout the day. The regular interaction between vehicles and walking pedestrians at the signalized and non-signalized site is one of the main features of traffic in our Indian cities. Junctions are the common places where at the same time vehicle and pedestrians interact with each other's. Due to the less discipline behaviour of the pedestrians and drivers on the road layout and not enough understanding in appropriate management of mixed traffic contribute much to traffic congestion and facilities. In India context over junctions designs generally vehicular friendly and in our designing part. We neglect the pedestrian and their movement. These junctions are important part of the road design and traffic operations. The level of exposure to accident is high at the junctions. The majority of accidents 30-40% (manual for the road safety in road design) of all reported road accidents happens on the junctions.

Through this study, I want to evaluate the performance of junction relate into pedestrian safety and their interaction with mixed traffic condition (developing countries) by creating different scenarios. In most of our junctions designing we neglect the pedestrian behaviour and their requirements. How pedestrians behave in mix traffic conditions, different environments and in different provided infrastructure.

1.4 AIM:

Decrease in pedestrian accidents and make junction pedestrian friendly.

1.5 OBJECTIVE:

- To study and stimulate the interaction of mixed traffic flow with pedestrian movement along the junctions.
- To Identify appropriate infrastructure requirements (supply side) for pedestrians along the junction.
- To study the performance of junctions with different traffic scenarios and generates safety measures for pedestrians.

1.6 RESEARCH QUESTION:

- How pedestrian behave and interact with vehicles at a junction in mixed traffic condition? Where there are signalized junctions but there is no pedestrians phase for pedestrians.
- And in what way one has to provide the infrastructure so that safety and delays can be overcome at the major junctions in a commercial area.

1.7 SCOPE AND LIMITATION

The focus of this study is pedestrian traffic and their feature. the pedestrian characteristics and their interactions with vehicles at the signalized junction.

The selection of the site was a challenge because every junction of the city suffers from similar problem. To select the appropriate site, visual survey of the major junction was done.

Manual counting of vehicles and pedestrian was done at the junction where pedestrian flow along the midblock of junction is not included.

1.8 METHODOLOGY

In the process of data collection from primary and secondary sources, the objective of the various surveys and generating model so that we can analyse the behaviour of pedestrian in different condition.

1.8.1 Literature Review:

To enhance the understanding of pedestrian behaviour through different pedestrians' models and what are the safety measures are taken in different around the world. Identify the parameter for the study.

1.8.2 Data Collection:

- Collection of secondary data regards to geometric design of roads,
- Collection of primary data

Pedestrian count and vehicle count at measure junction with different type of land use and some survey related to walking ability of pedestrians in the same area.

1.8.3 Compilation of Data:

The stage is meant for compiling the collected primary as well as secondary data and associating in order to fill the gaps in the existing data.

1.8.4 Analysis of Data:

Analysis of data both primary and secondary is essence of dissertation. Analysis of data is performed with the help of AUTOCAD and GIS software to create the model. what measures are required for safety in different land uses. Finally, it shows the goal of the thesis.

1.9 REPORT STRUCTURE

Chapter 1 introduction about pedestrian's safety and methodology of the thesis

Chapter 2 Literature Review

Chapter 3 Data collection and Analysis

Chapter 4 Conclusion and Recommendation

CHAPTER-2 LITERATURE REVIEW

2.1 PEDESTRIAN STUDIES

Enough literature is available on pedestrians modelling and simulation. Pedestrian studies are divided into two parts i.e., pedestrian data collection and pedestrian analysis. Further data collection and analysis can be done in two ways i.e., Macroscopic and microscopic level.

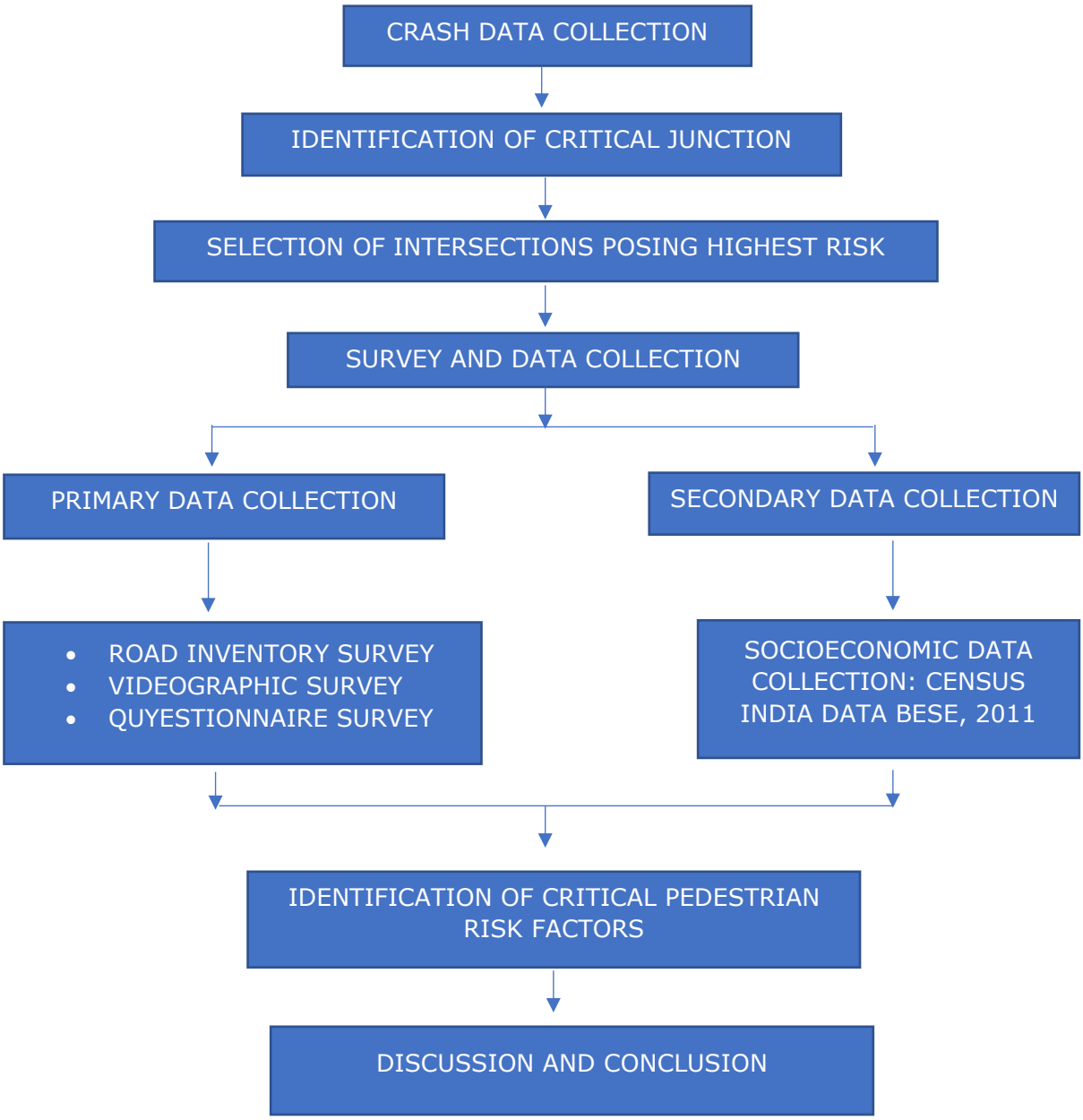


FIGURE 2.1 PEDESTRIAN DATA COLLECTION

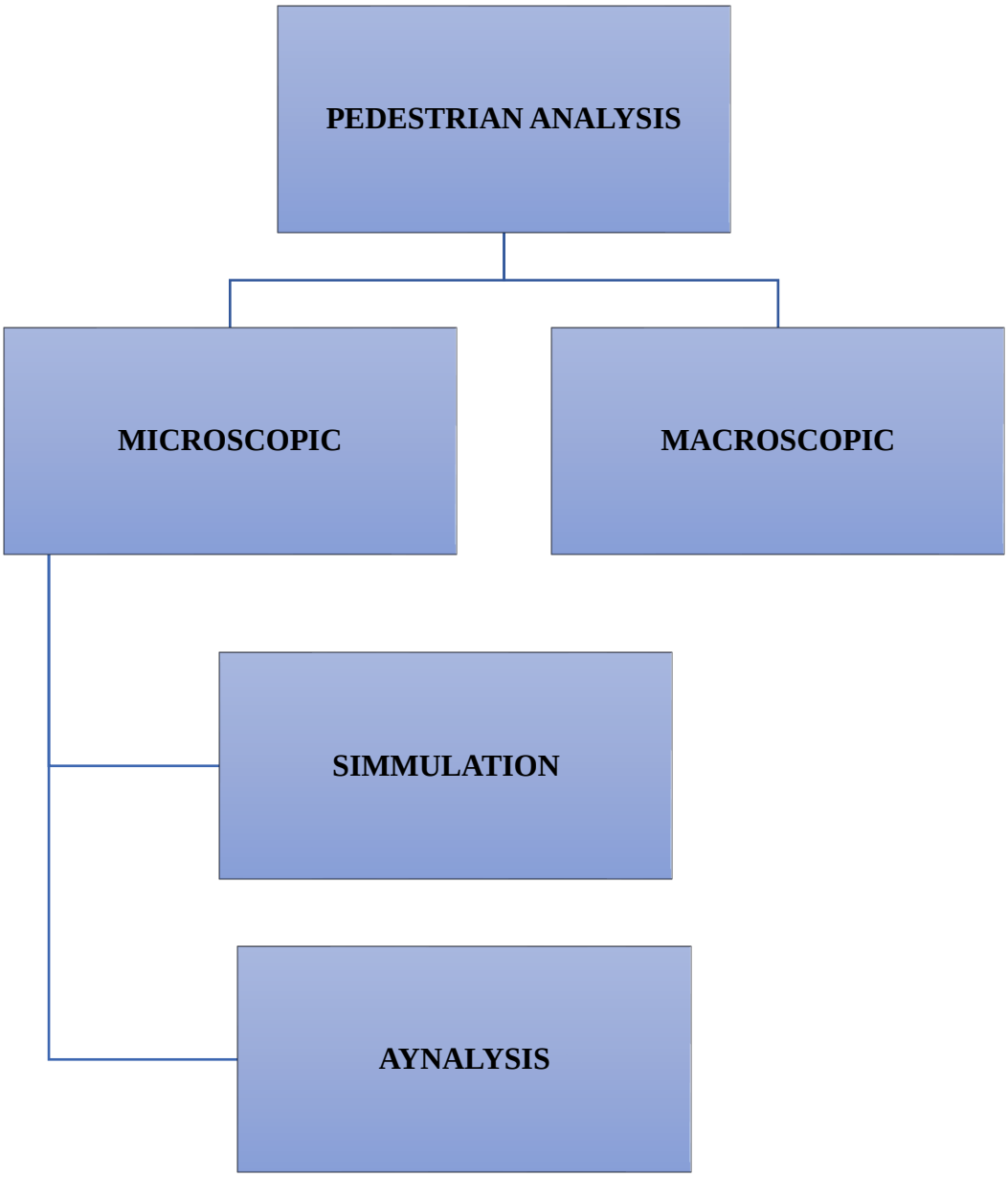


FIGURE 2.2 TYPES OF PEDESTRIAN ANALYSIS

2.2 MACROSCOPIC AND MICROSCOPIC STUDIES:

Macroscopic studies were first being suggested by Navin & Wheeler (1969) in their pedestrians is treated in the group (movement and behaviour etc.). In these we analysed the movement of the whole group along the junction, shop, Bus stand etc. were at microscopic we analysed the individual

pedestrian and their attribute. Microscopic studies are in detail one. Further microscopic studies are again divided into two parts i.e., Simulation and analytical.

2.3 SIMULATION

The simulation model is an abstraction of a real system that retains the system essential aspects. The simulation model can be either to enhance the understanding of how the system works or to investigate the potential effects of proposed modification of the system. simulation models can be either deterministic or probabilistic.

2.3.1 System

- A system is a set of objectives with relationship between the object and their attribute.

2.3.2 Model

- A model is an idealized representation of reality.

2.3.3 Simulation model

Dynamic representation of some part of real world. Achieved by building a computer model & moving it through time.

2.4 PEDESTRIAN ANALYSIS BY SIMULATION

In micro-simulation model every pedestrian treated as single unit. Simulation offers more flexibility for the analysis. It is safe and cheaper. Simulation offers the ability to determine in advance the effect of increase the effect of traffic flow (pedestrian flow) on existing facilities. The effect of signals, speed limits, sigs, and access control all can be studied in detail without confusing or alarming drivers. The simulation model is not just another means of accomplishing what we can do today but is a tool for solving problems which cannot be solved today. There are several microscopic simulation models available.

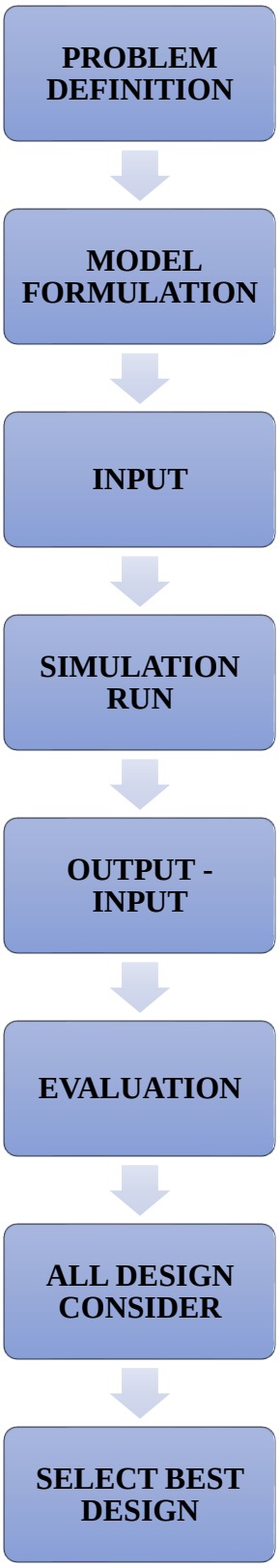


FIGURE 2.3 HIREARCHY OF SIMULATION

2.5 CASE STUDY

2.5.1 Pedestrian Simulation at Pont Kuss

In Strasburg (France) there is a location known as point courses. At Pont kuss a number of safety issues related to pedestrian traffic are reported. They motivated to assess and solve this issue through simulation. It concluded that simulation is a powerful tool to handle the traffic flow with safety. They develop 10 fields of action to improve the conditions of pedestrians in the city of Strasburg out of which 4 which related to my study.

- To improve the walking
- Redistribute the road space in favor of pedestrian.
- Reduce conflict between pedestrian and bike.
- Arrange road node to pedestrian friendly.

2.5.2 Traffic at point courses:

Authority of Strasburg decided to do micro simulation of traffic using VISSIM at one of the major hotspot sites i.e., at Point Kuss. Point Kuss is a connecting bridge between old town and the railway station. They did count of the pedestrians and vehicles along the Pont Kuss Bridge. According to their findings 1849 pedestrian flow in both directions using 2 m sidewalk were as 250 vehicles per hour in two lanes. Which implies that even if all

FIGURE 2.4 LOCATIONOF PUNT KUSS BRIDGE

Source: multi modal simulation base planning for pedestrian by T Kretz

cars were fully occupied a citizen using a car would be granted to more public space than a walking citizen? And they already mention in their 10 actions of the plan. That redistribution of the road space must be in favour of pedestrian Geometry of Pont kuss area Pont Kuss is a bridge connecting the old city with the Strasburg railway station.

Red =public transport, Orange= motorized traffic

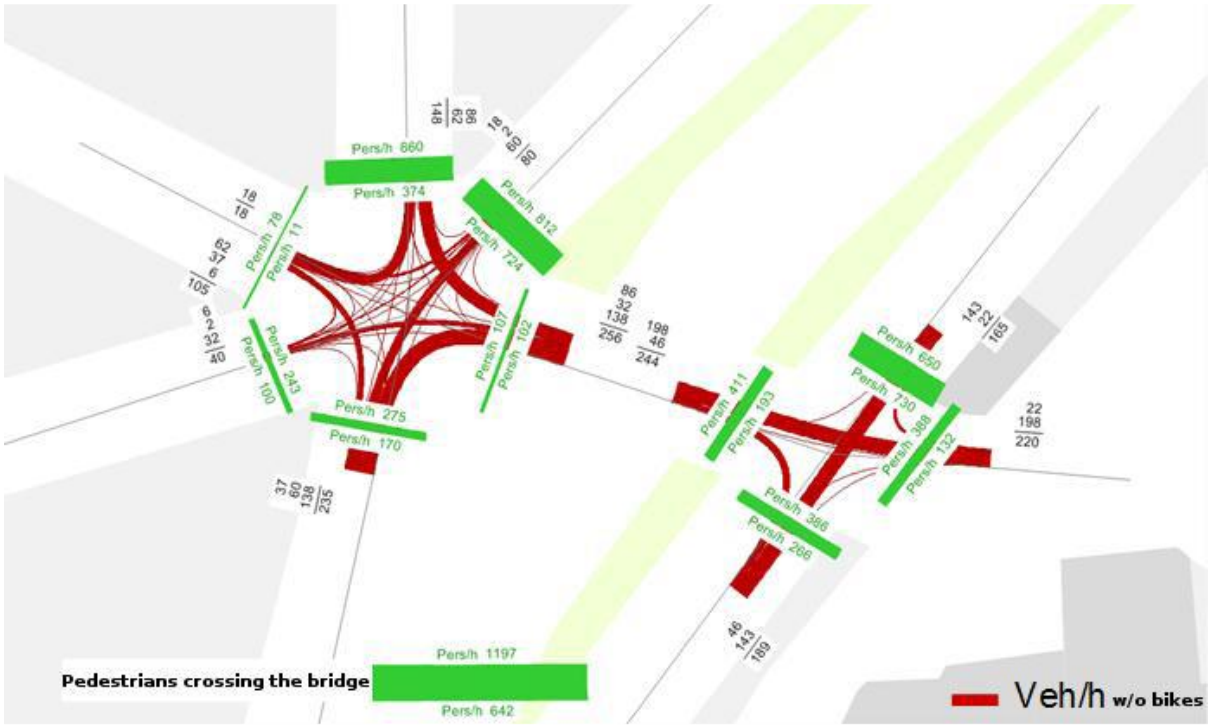


Figure 2.5 PCU AT PONT KUSS INTERSECTION

Source: multi modal simulation base planning for pedestrian by T Kretz

2.5.3 Issues at Pont kuss location:

Pedestrian from the western side did not follow the intended path. And the current signalization is such that if pedestrians follow the signal, they must wait twice. The second problem is that pedestrian did not use the provided sidewalk for the movement they invade in the road lane.

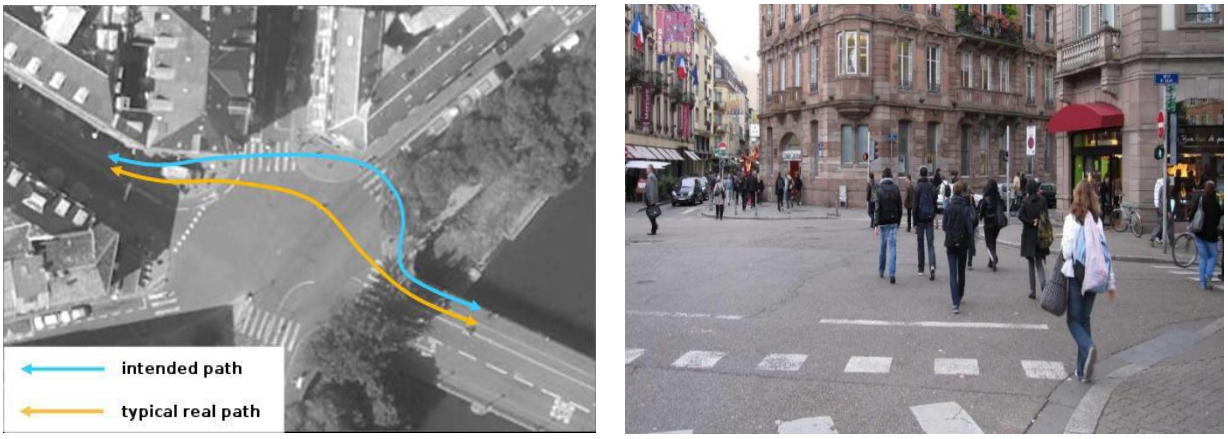


Figure 2.6 PEDESTRIAN ROUTE IN PONT KUSS

Source: multi modal simulation base planning for pedestrian by T Kretz

2.5.4 Data requirement

- Vehicle count
- Pedestrian count
- Detail's layout of Pont Kuss bridge and junction
- Video graphic survey

All their data put in VISSIM software according to the procedure and then=m simulation run, and we can generate different scenarios

With the help of VISSIM they calculated the LOS of the junction and the pedestrian and vehicular demand put in the VISSIM software

Not to solve the problem by make three scenarios:

First scenario Do nothing in this scenario they modelled and simulation that pedestrian and vehicle without making any change in junction and in a traffic signal. In second and third scenario they change the traffic signal plan and width of sidewalk as shown in figure than simulate the whole area they use the conflict analysis and right-side priority rule of VISSIM to simulate the junction. They simulate the waiting time of pedestrian and

vehicles along the junction. All three scenarios are analysed, and they select the most efficient one where minimum vehicle delay and maximum pedestrian movement happens.

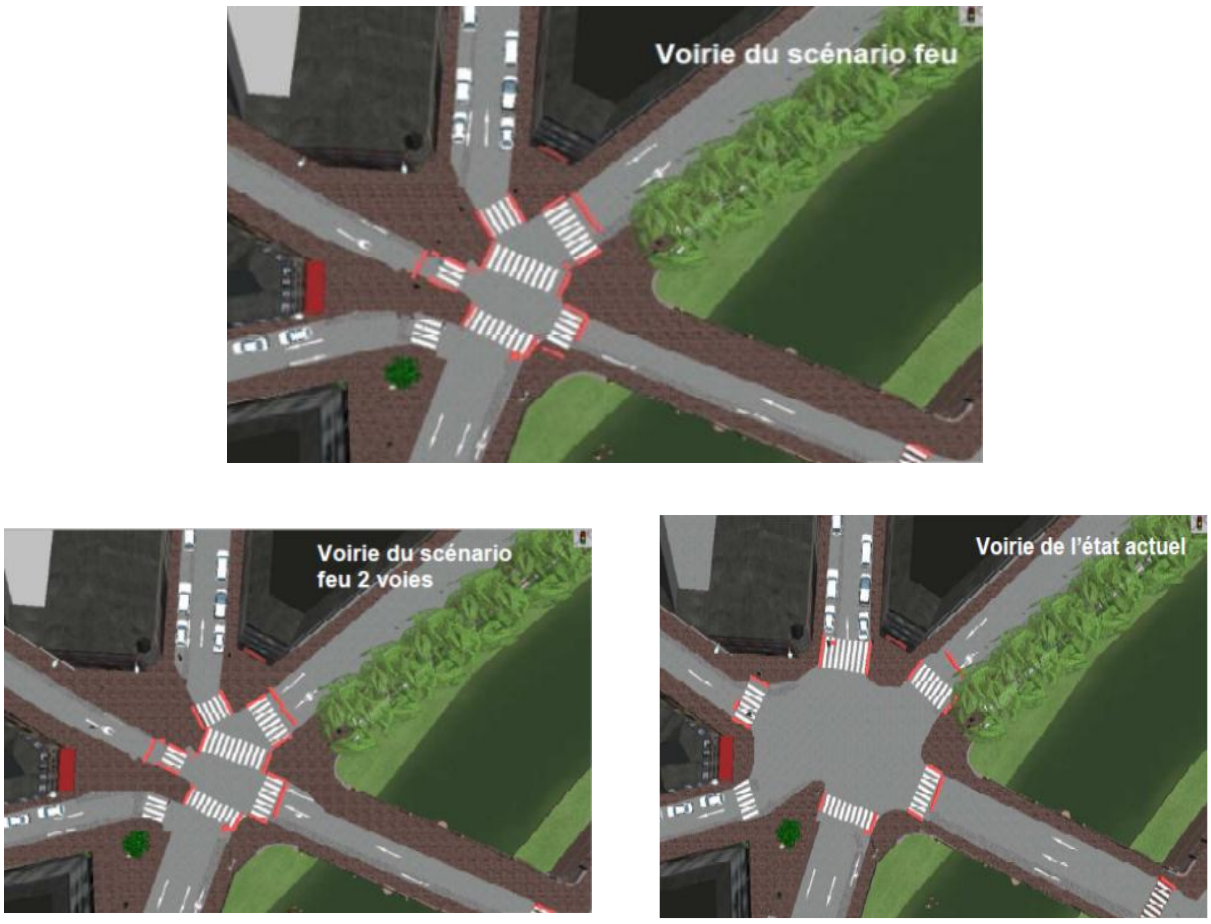


FIGURE 2.7 DIFFERENT SCENARIO TESTED IN SIMULAION

From this case study a clear idea comes that how can be design supply side infrastructure in an efficient way and with our objective of pedestrian safety in our mind with minimum vehicular delays. There detail studies help use to understand the requirement of pedestrian which are highly neglected in Indian cities.

Chapter-3 Data Collection and Analysis

3.1 Overview of Ahmedabad

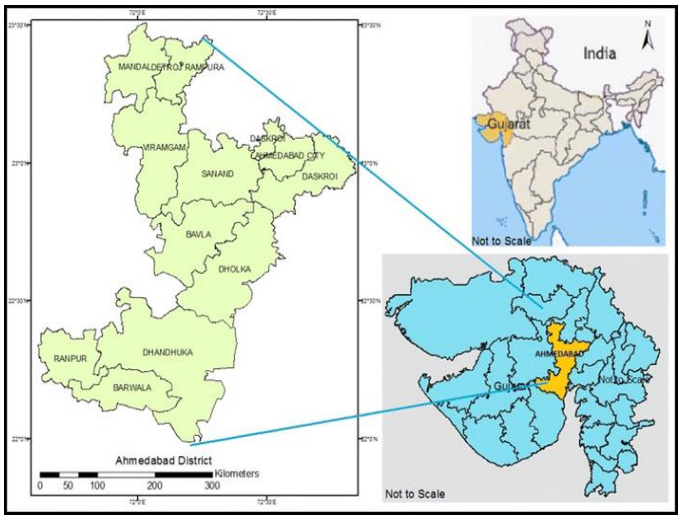


FIGURE 3.1 LOCATION OF AHMEDABAD

FIGURE 3.2 REGIONAL CONNECTIVITY

Ahmedabad is seventh largest metropolis in India and the largest city of Gujarat state. The settlement of the city is among on the banks of Sabarmati river. Ahmedabad has been one of the most important centers of trade and commence in western India it is also a major industrial and financial city. 72.1 lakh population in Ahmedabad district. 12% of state population only Ahmedabad district Ahmedabad population highest in state. The city direct connected with NH and state highways and well-connected railways to neighboring cities.

The AUDA comprises of 4 districted 9 talukas 5 census town 23 outgrowths. It is observed that concentration of highest density is in the central areas, gradually reducing towards the periphery with fragmented growth towards the northwest and west as compared to east due to economic centers and contiguous growth along the corridor.

Ahmedabad is the commercial capital of Gujarat due to its thriving economic centers. It also hosts the headquarters of major public-sector banks. Ahmedabad Dist. Co Op Bank, Ahmedabad Mer- cantile Co-Op Bank Ltd, Ahmedabad Mercantile Co Op Bank, Dena Bank, etc. Major Economy

generators such as Textile works, Auto- mobile & parts manufacturing, and Pharmaceuticals are predominantly located in and around the district.

3.2 Database and Method

Used In India, the data regarding road crashes is jointly handled by the City Traffic Police and the City Police. The details of the day-to-day road traffic crashes are recorded in local police stations across the country in the form of an FIR (First Incident Report) the notice of comes to know about the City Traffic Police keeps a record of all road crashes in the city by collecting a copy of the relevant FIR from various police stations in the city. The road crashes data (Fatal and Serious Road Crashes) used for the purpose of this study have been sourced from FIRS (2009- 2020) collected from the City Traffic Police Commissioner's office

3.3 Fatalities and Serious Injuries Trend in Ahmedabad

Road crash trend analysis over the last decade suggests that fatalities as well as serious injuries have gradually risen in Ahmedabad. In 2019, road

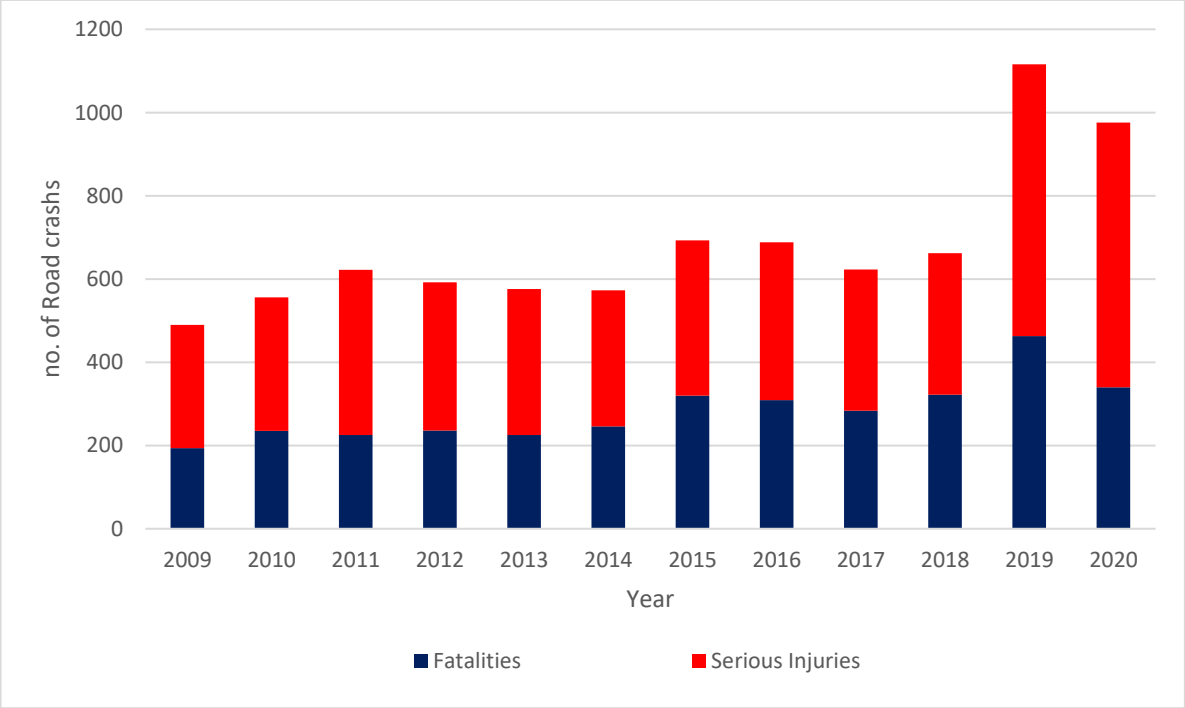


FIGURE 3.3 ROAD CRASH TREND ANALYSIS

traffic road crashes cost 463 lives and seriously injured 653 people in the city.

Where in 2020 it is absorbed that under covid situation the rate of accident is slightly less than 2019. There is 47.43% increase in accident from 2018 to 2020 and 12.54% decrease in accidents from 2019 to 2020. Fatality rate per lakh population is 6.99 in 2019 and 5.02 in 2020.

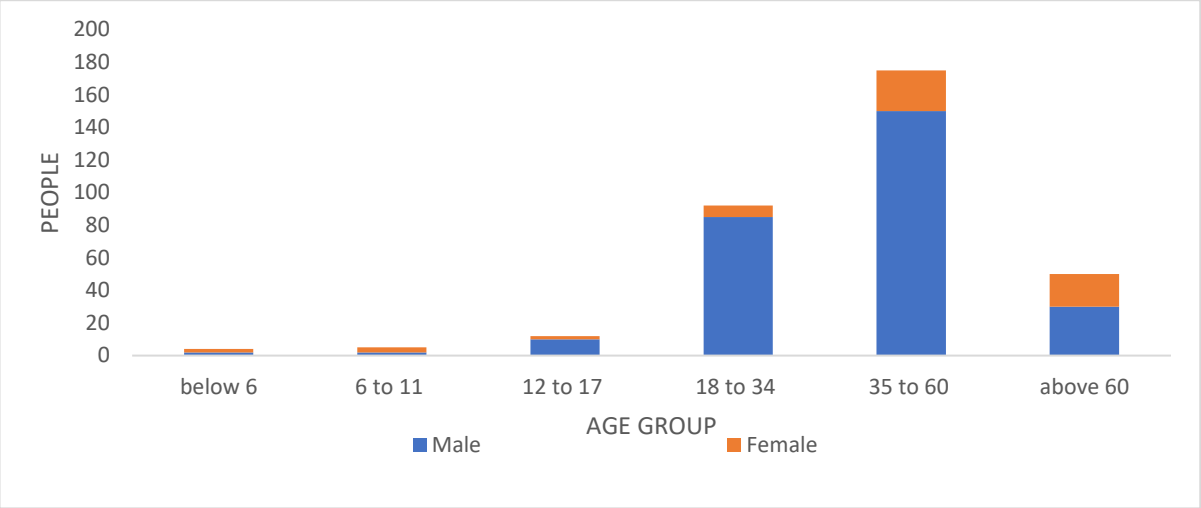


FIGURE 3.4 FATALITIES BY AGE GROUP 2020

Of the total fatalities in the last decade, 80 percent of those affected are males, which is typical of any urban area in a developing country where the

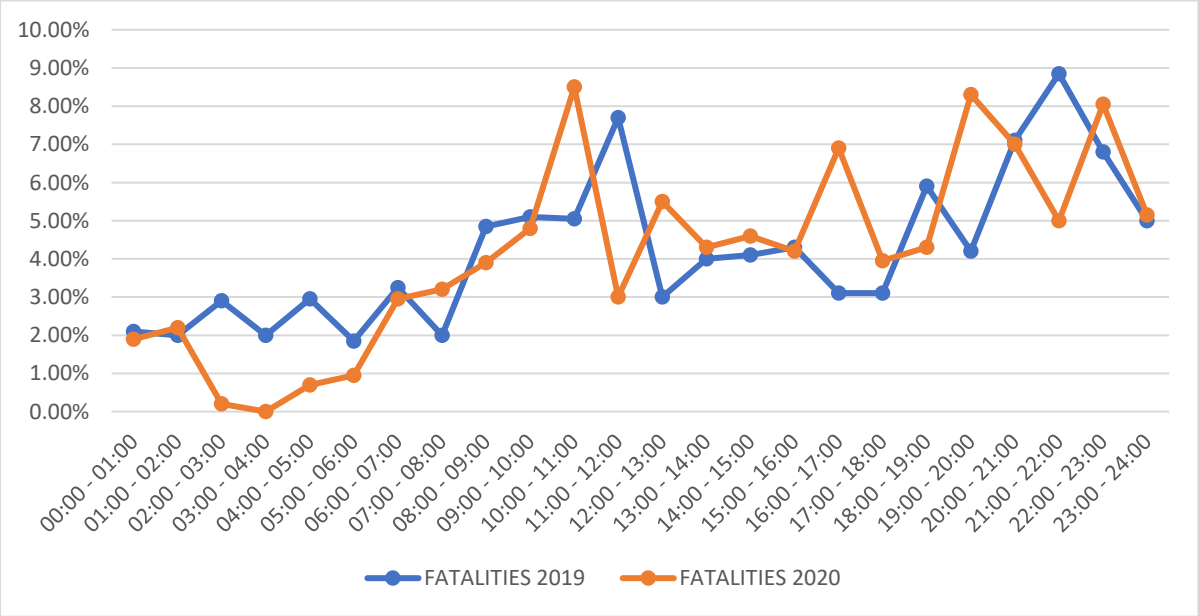


FIGURE 3.5 TIME - WISE FATALITIES IN YEAR 2019 AND 2020

male work participation rates are higher than those of females. It is also seen that 78 percent of the fatal and serious road crashes are in the economically productive age groups (between 18–60 years) followed by senior citizens (over refer to Figure). This indicates vulnerability of the family in the case of road crashes, as the male members are the earning members of the family and such incidents impact the overall socioeconomic condition of the family, affecting the education of children, productivity of the working population and the overall quality of life (World Health Organisation, 2015).

The time of the day also seems to have an impact on road crashes. It is observed that in the case of Ahmedabad, most of the fatal road crashes take place during the peak hours (9am to 11am and 6pm to 8pm). If we compare the 2019 and 2020 numbers, it is seen that the share of fatalities in the evening peak hours have almost doubled, from 4 percent in 2019 to 8 percent in 2020.

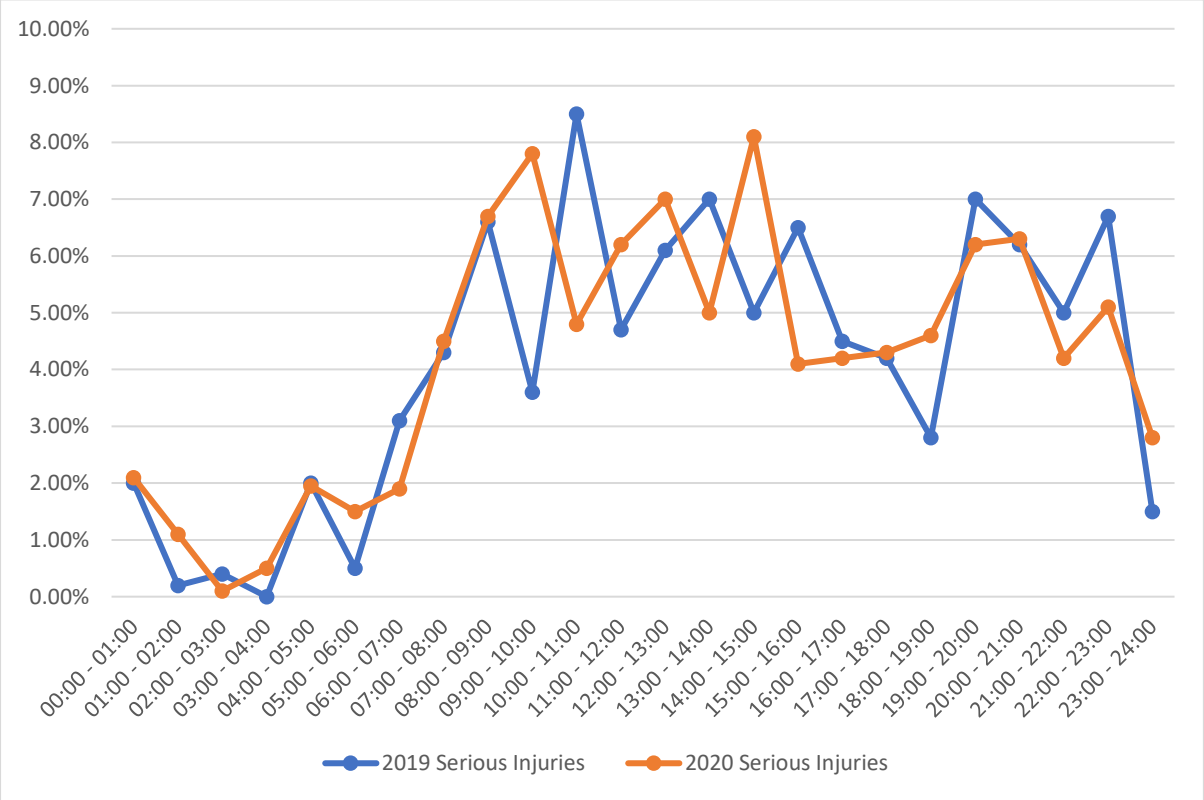


FIGURE 3.6 WISE SERIOUS INJURIES IN YEAR 2019 AND 2020

The time of the day also seems to have an impact on road crashes. It is observed, most of the Serious injury's road crashes take place during the peak hours (9am to 11am and 6pm to 8pm). If we compare the 2019 and 2020 numbers, it is seen that the share of fatalities in the morning peak hours have almost doubled, from 5 percent in 2019 to 9 percent in 2020.

3.4 Affected Modes

the pie chart shows the comparison of 2009 and 2019 affected modes for fatalities. As shown in the pie chart it can be seen that the highest impact in accidents is on pedestrians. There is a vast increase of 7% affecting pedestrians from 2009 t0 2019 while happening due to cycles. Accordingly,

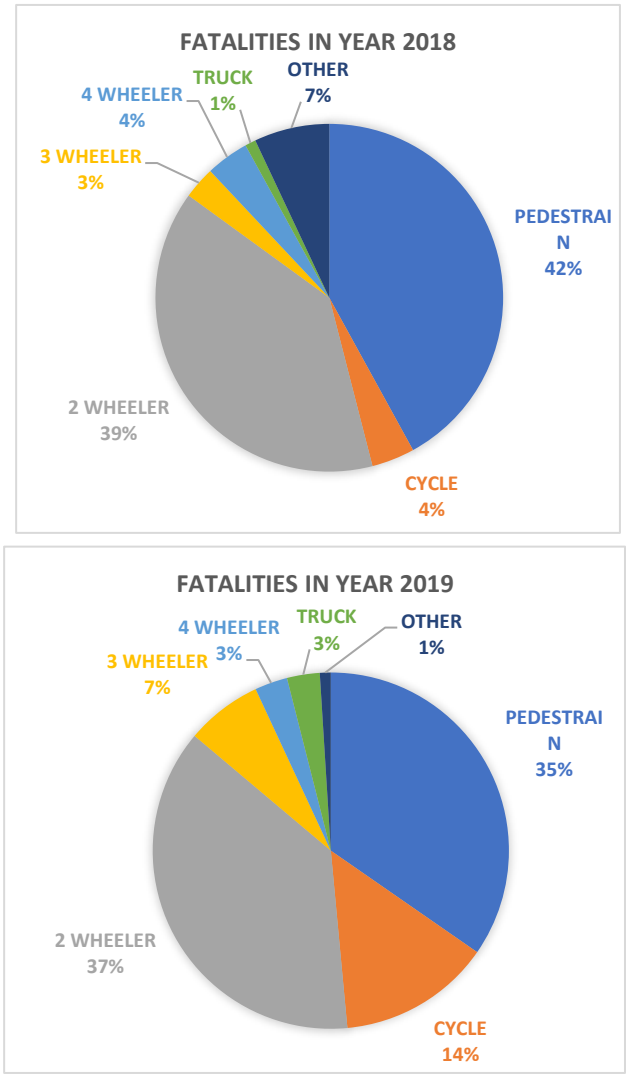


FIGURE 3.7 COMPARISON OF 2009 AND 2019 AFFECTED MODES FOR FATALITIES

the vehicle users are affected as per but the number of accidents affecting vehicle users is gradually decreased for three wheelers and trucks.

The above given figure shows the comparison percentage of pedestrians, cycle users, vehicle users and heavy vehicle users affected and injured due to accidents from 2009 and 2019.. There is not much difference in serious injuries faced by pedestrians but on the other side it has the highest percentage with 41% which is a very serious matter to be considered. In second place comes the two-wheeler vehicle users with 39% in 2009 and increased to 50 % 2019. In the same way all the vehicles facing accidents

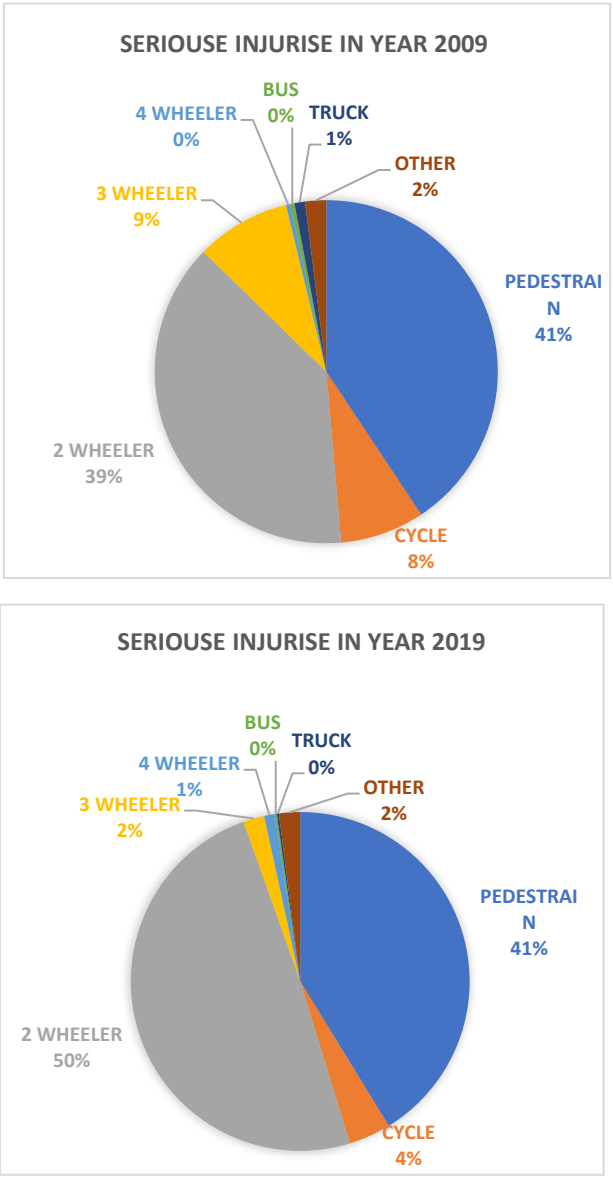


FIGURE 3.8 COMPARISON OF 2009 AND 2019 AFFECTED MODES FOR SERIOUS INJURIES

had injuries in certain amounts which is shown as percentage in the above given pie chart.

3.5 Responsible Modes

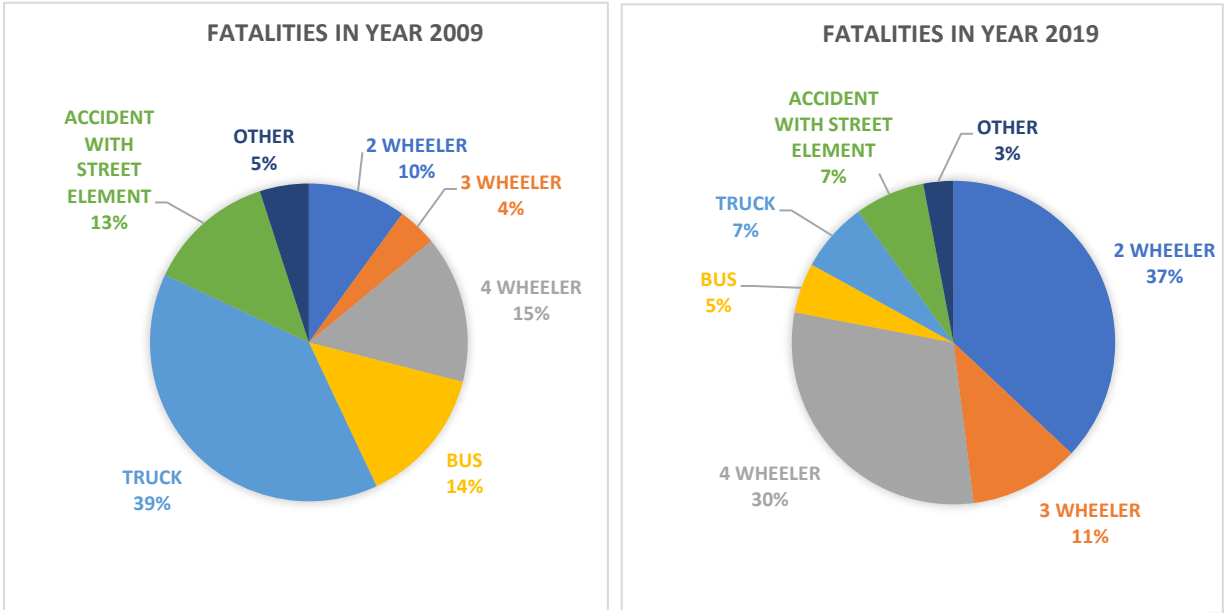


FIGURE 3.9 COMPARISON OF 2009 AND 2019 RESPONSIBLE MODES FOR FATALITIES

The above given figure shows the responsible mode of fatalities of 2009 and year 2019. fatalities due to private mode of vehicles (two-wheelers and four-wheelers) are on the rise. However, within the privatized modes,

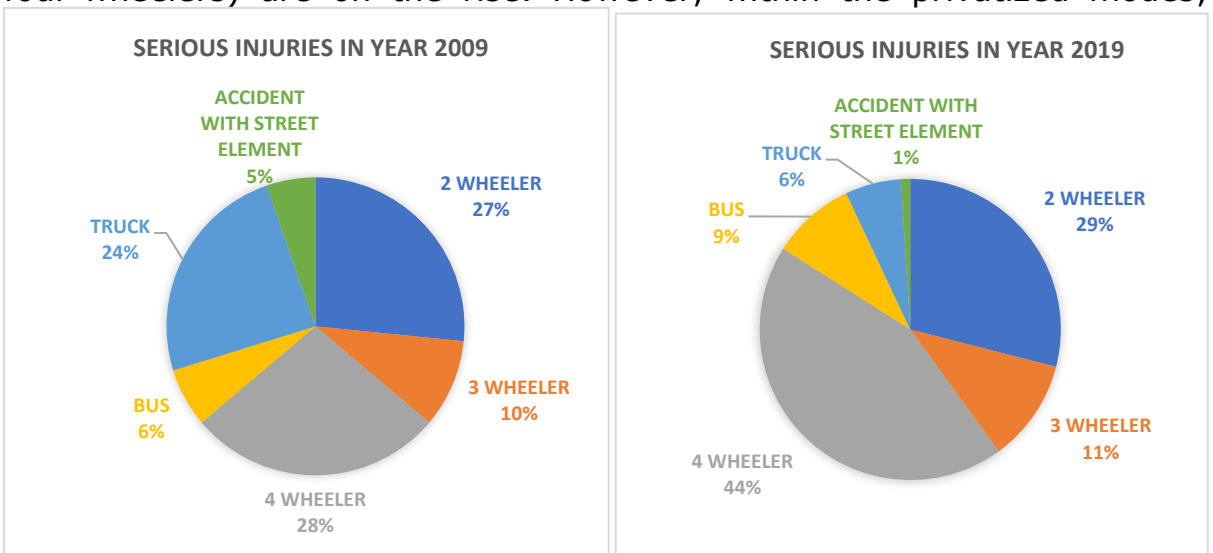


FIGURE 3.10 COMPARISON OF 2009 AND 2019 MODES RESPONSIBLE FOR SERIOUS INJURIES

fatalities in the case of two-wheelers have more than doubled in the last 11 years. In the case of cars, the number has almost doubled It can be observed that truck and two-wheeler vehicles are mainly responsible for the maximum number of accidents though there is a decrease in the percentage of two-wheeler responsible by year 2019. Other road elements are the major cause of accidents with 13% in 2019.

The above given figure depicts that. In the case of serious injuries, it is observed that 73 % of total serious injuries were attributed to cars and two wheelers in 2019. Trucks possessed 24% serious injuries in 2009.

Year	Fatal	Serious Injuries	Affected mode	Responsible mode
2018	322	340	TW, Pedestrian	TW
2019	463	653	TW, Pedestrian	4-Wheeler
2020	340	636	TW, Pedestrian	TW

TABLE 3-1 NUMBER OF FATAL AND SIRIOUSINJURIES

Road crash trend analysis over the last decade suggested that fatalities and serious injuries have gradually risen in the Ahmedabad that under covid situation the rate of accident slightly less than 2019 in 2018 road traffic accidents cost 322 lives and serous injured 340 people in the city of Ahmedabad. in 2019 road traffic accidents cost 463 lives and serious injuries 653 people in the city of Ahmedabad. in 2020 road traffic accidents cost 340 lives and serous injured 636 people in the city of Ahmedabad.

Responsible mode / Effected mod	2w		3w	4w	Bus	Truck	Others	Total
Pedestrian	30		15	26	9	24	37	141
Bicycle	2		-	4	-	3	6	15
2w	80		7	19	7	23	11	147
3w	-		12	4	1	5	1	23
4w	-		-	6	-	3	-	9
Truck	1		-	1	-	1	-	3
Others	1		-	-	-	1	-	2
Total	114		34	60	17	60	55	340

TABLE 3-2 FATALITIES BY AFFECTED AND RESPONSIBLE MODE 2020

it is found two-wheeler & four-wheeler are most responsive and the effected mode in fatal followed by pedestrian as the effected mode and two-wheeler as responsive for contributing the fatal accidents.

3.6 Identification of accident hot spots

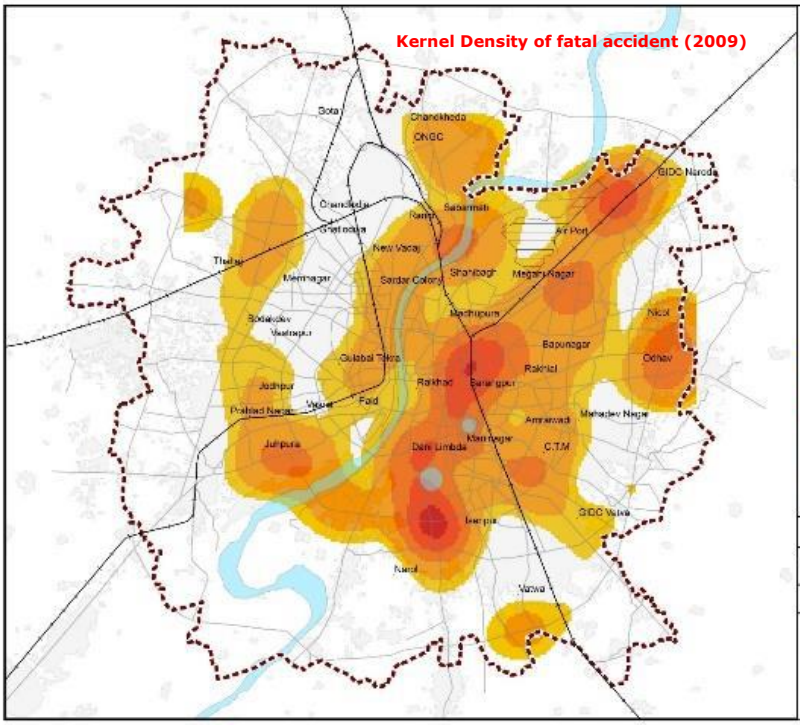


FIGURE 3.11 KERNEL DENSITY OF FATAL ACCIDENT (2009)

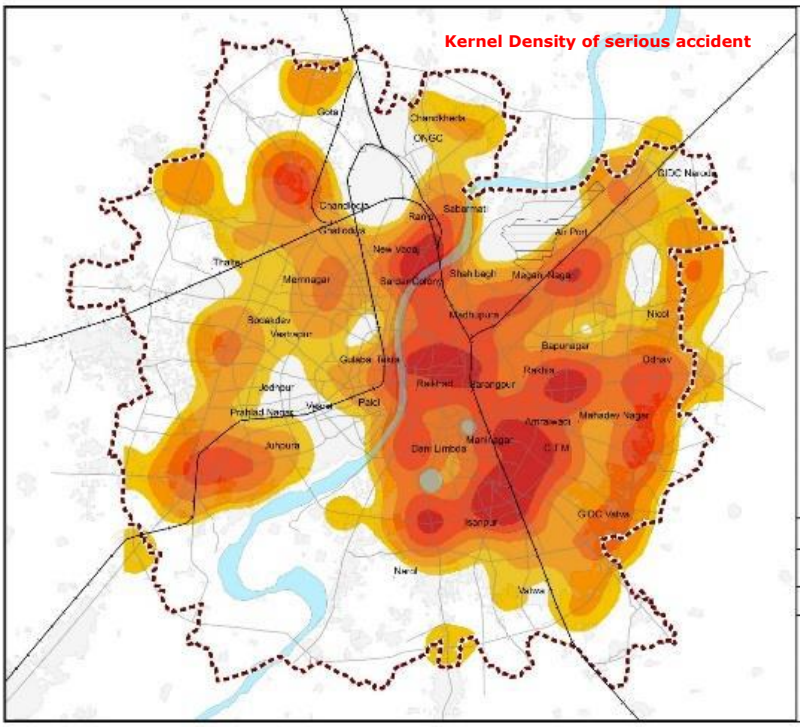


FIGURE 3.12 KERNEL DENSITY OF FATAL ACCIDENT (2019)

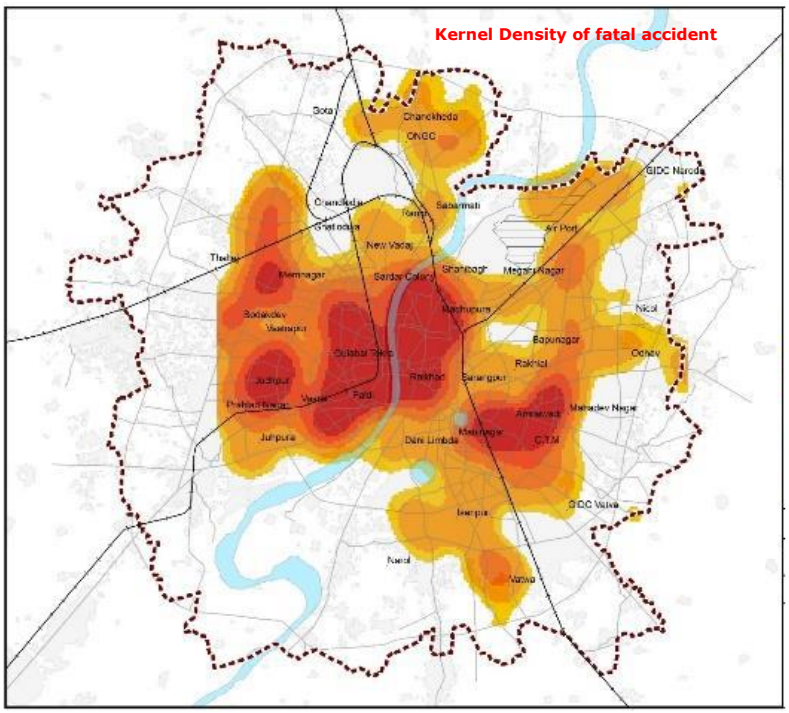


FIGURE 3.13 KERNEL DENSITY OF FATAL ACCIDENT (2019)

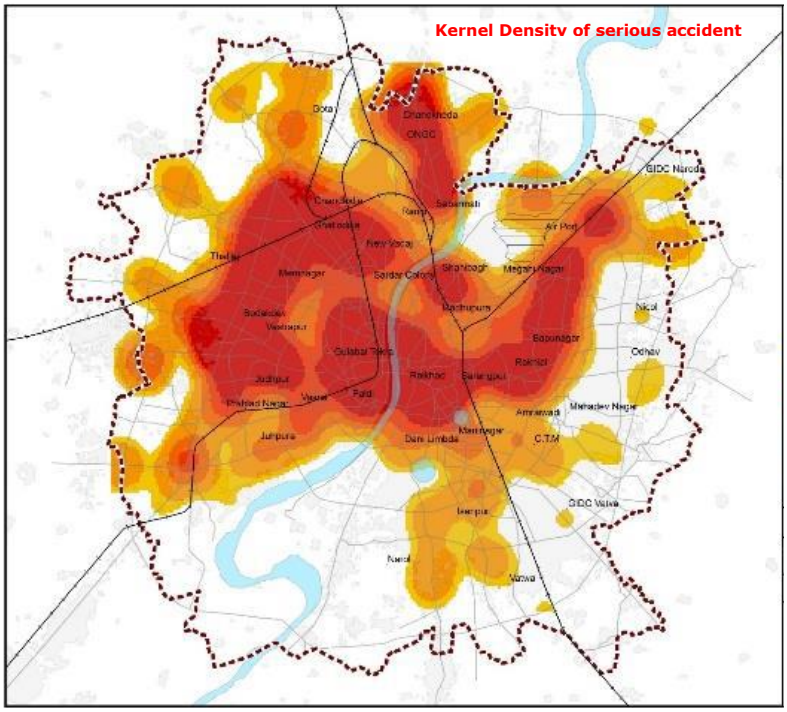


FIGURE 3.14 KERNEL DENSITY OF SERIOUS ACCIDENT (2009)

Kernel Dencity of fatalities and serious injuries accident in 2009 to 2019 whereas some area came up. Narol naroda road major density obsevatd also Vatva road and junction of jawahlal nehru road asram road and narol sharkej road seen high density and on SG highway

Ahmedabad city in major road crash junction name are Naroda Patiya junction, Narol junction, Vatva junction, Thakkarbapa Nagar, CTM junction, Isanpur junction, Vishal junction Paldi junction, Parimal garden junction, RTO junction, Ellishbridge junction, Akhabarnagar junction, and also SG highway junctions.

Major location	Fatalities (pedestrian)
Vatva junction	**10**
Narol junction	**4**
Paldi jinction	**8**
Naroda padiya	**11**
Ctm	**7**
Ashram road	**6**
SG Highway	**8**

TABLE 3-3 NUMBER OF PEDESRIAN FATALITIES

Pedestrian fatalities mainly observed Narol junction, Naroda junction, Vatva junction, Paldi junction, Naroda Natiya junction, CTM junction, and RTO junction.

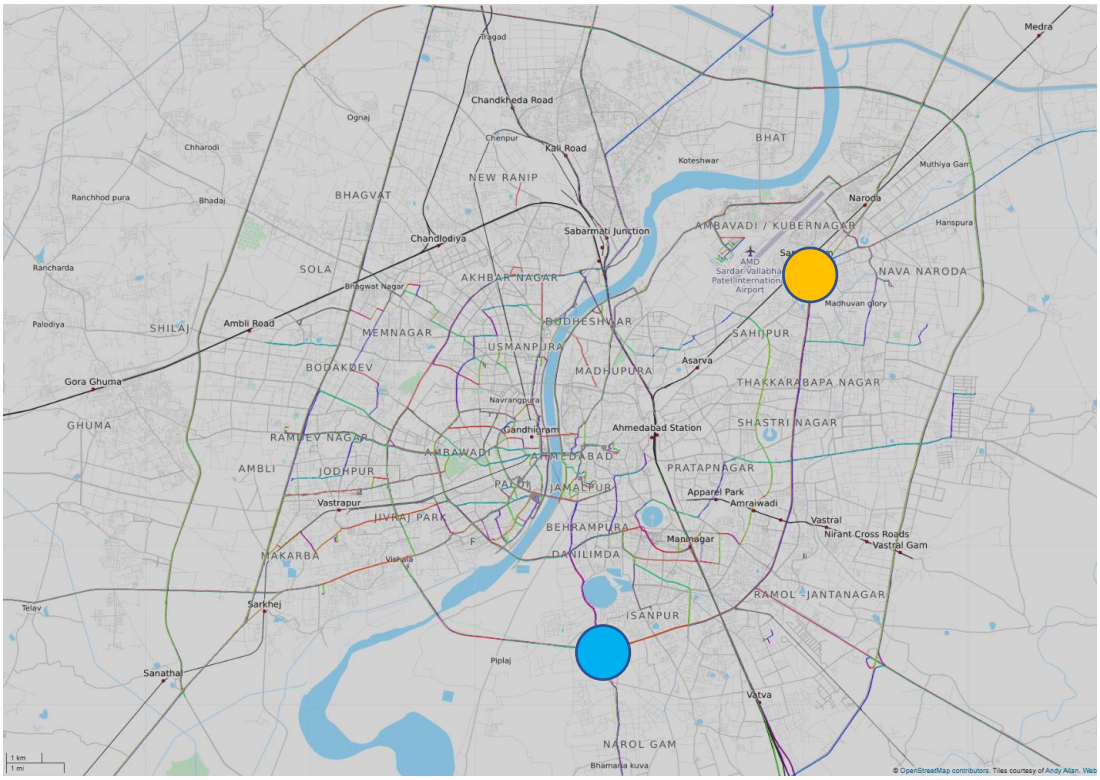


FIGURE 3.15 LOCATION OF JUNCTION

Orange circle – Naroda Patiya junction Blue circle – Narol junction

From all the above data we give randomly two junctions. One is Naroda Junction, and the other is Narol Junction. Naroda Junction is in the north direction of Ahmedabad and Narol Junction is in the south direction.

3.7 NARODA PATIYA JUNCTION

3.7.1 BACKGROUND

Ahmedabad International Airport and SP Ring Road near the Naroda Patiya junction. It is near Bapunagar. Kalupur and Krishnanagar, the geographic centre of Ahmedabad, are 5 km away. Naroda GIDC industrial park hosts national and multinational corporations such as Reliance Industries Ltd, PepsiCo, Ingersoll-Rand, Dresser Industries, Lubi Elcectronics, Lubi Pumps, Harshtaiana, Laxmi Engineers Arvind Mills, Umiya Textile and Nirman Textile. India's snack food manufacturer Havmor Ice Cream Ltd, Samrat Namkeen is located near Naroda Patiya junction

FIGURE 3.16 NARODA PATIYA JUNCTION

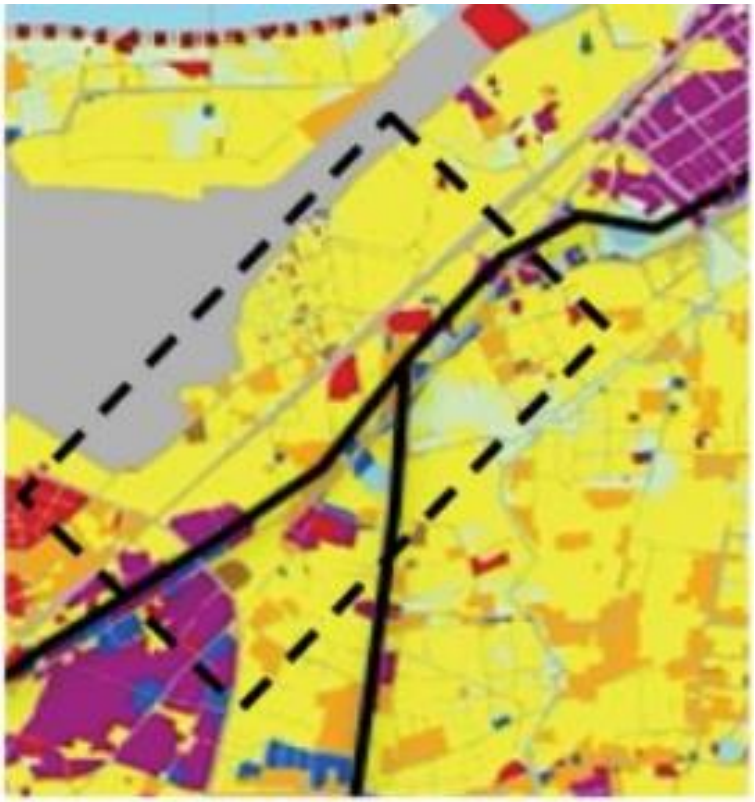


FIGURE 3.17 LAND USE OF NARODA PATIYA JUNCTION

Naroda road to NH8 intersected by Naroda patiya circle junction also consists of Brts corridor having excessive and very high traffic flow. It is observed.

Total Fatalities: 13 (2019)

Affected mode: 3 Two-wheelers and 8 Pedestrian 2 cars

Responsive mode: 2w. 4w and BRTS Issues

3.7.2 ISSUES IDENTIFIED

- Encroachments near junction by hawkers
- Shuttle auto rickshaws parked near junction.
- Inconvenience to traffic due to mixed land use near junctions
- Improper parking at the junctions

- Excessive traffic during peak hour
- Speeding
- Inadequate signages
- Absence of proper traffic separator
- Lack of speed reduction units in the junctions
- Inefficient signal system

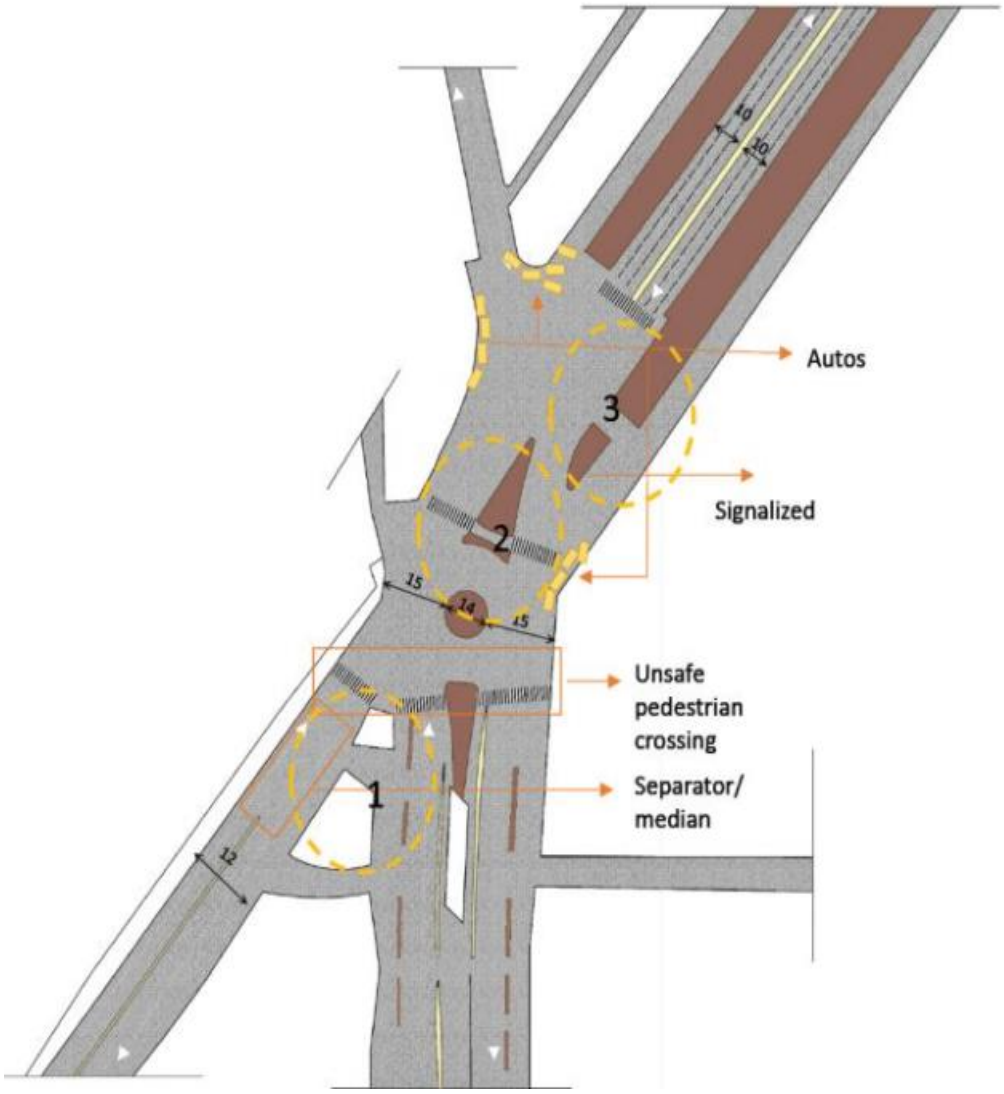


FIGURE 3.18 NARODA PATIYA JUNCTION ISSUES

3.8 Data collection of Naroda Patiya junction

Data for a pedestrian count and vehicle count was done through manual counting, whole intersection measured manually. All these surveys were done in the peak hours. The pedestrian data collection period accurate during the morning peak period (8:45 am – 11:15 am) and evening peak period (5:00 pm – 7:00 pm) on Thursday June 10,2021 and the two hour assigned period was divided into eight intervals for ease of counting.

3.9 Pedestrian Analyses of Naroda Patiya Junction

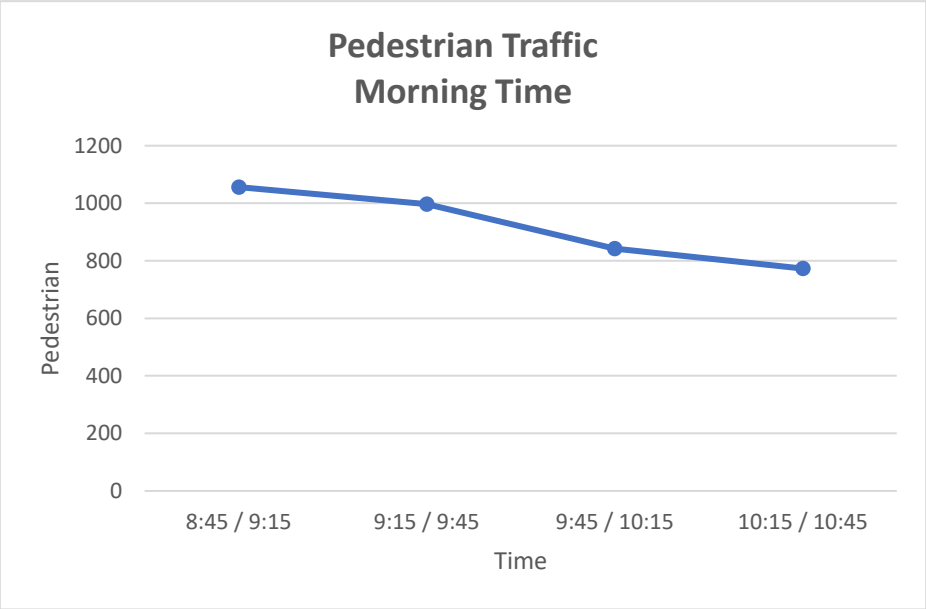


FIGURE 3.19 PEDESTRIAN TRAFFIC MORNING TIME (NARODA JUNCTION)

Morning peak hour are from 8:45am to 9:15 am During morning the number of pedestrians crossing the road is higher. Because during morning time shops and people have to go for job in morning time so there is more pedestrian traffic and also this time to open the government office so the number of pedestrians increases at this time

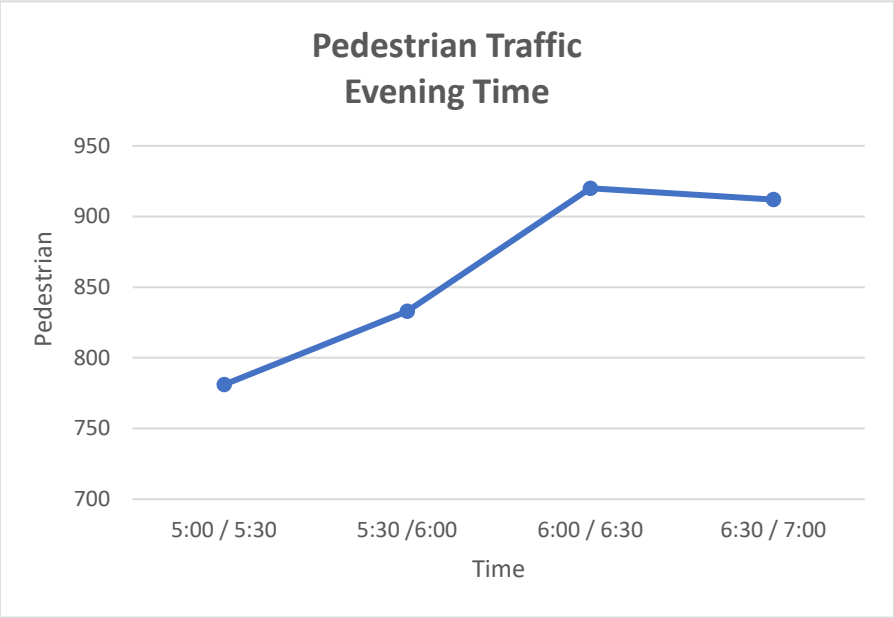


FIGURE 3.20 PEDESTRIAN TRAFFIC EVENING TIME (NARODA JUNCTION)

Evening peak hour are from 6:00pm to 6:30pm. During evening, the number of pedestrians crossing the road is higher. Because during evening time shops and restaurants attracts the people beside this government approach to there home as its office closing time.

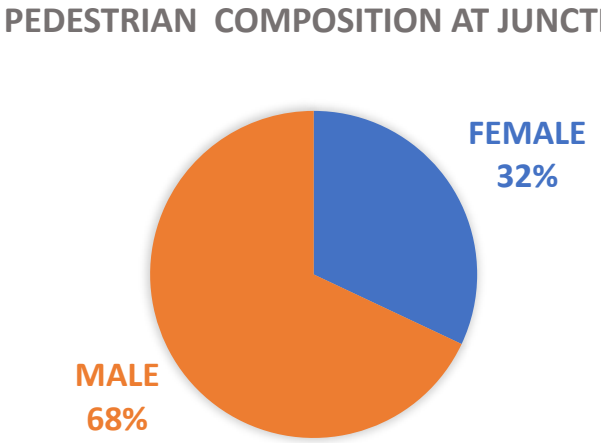


FIGURE 3.21 PEDESTRIAN COMPOSITION AT JUNCTION (NARODA JUNCTION)

The number of males in the pedestrian is more because there is GIDC and shop near the junction most of the male work there so the number of female is less.

It is observed that there is no pattern in the moment of pedestrians. Pedestrian did not obey the rule and the just cause the road stochastically. In our observation we found that 63% of people did not follow the traffic rule.

3.10 Vehicle Analysis

3.10.1 Vehicle type

2w: Scooter/motorcycle

3w: Auto Rickshaw

4w: car/van/jeep

Bus: bus/minibus

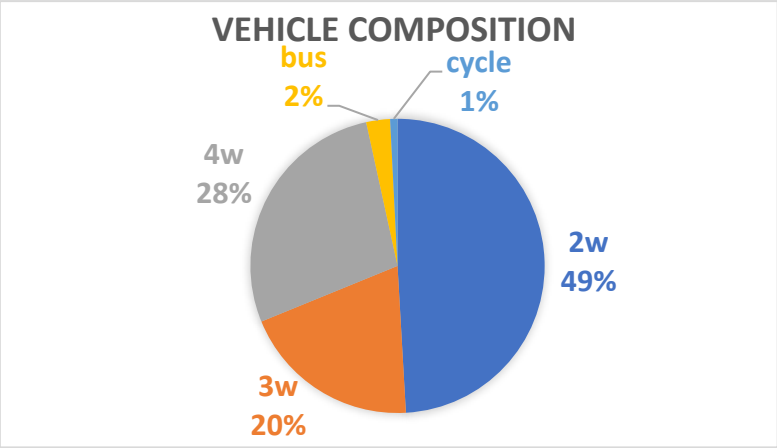


FIGURE 3.22 VEHICLE COMPOSITION (NARODA JUNCTION)

Two-wheeler has a major percentage in vehicle composition. Generally, in Indian scenario two-wheeler drivers behave very stochastically and creates problem along the junction. Three-wheeler has 20 percentage and four-wheeler has 28%

3.10.2 Phase plan at 15 minutes interval morning time

FIGURE 3.23 VEHICLE COMPOSITION PLAN AT 15 MINUTES INTERVALE (MORNING TIME) (NARODA JUNCTION)

3.10.3 Phase plan at 15 minutes interval evening time

FIGURE 3.24 VEHICLE COMPOSITION PHASE PLAN AT 15 MINUTES INTERVALE (EVENING TIME) (NARODA JUNCTION)

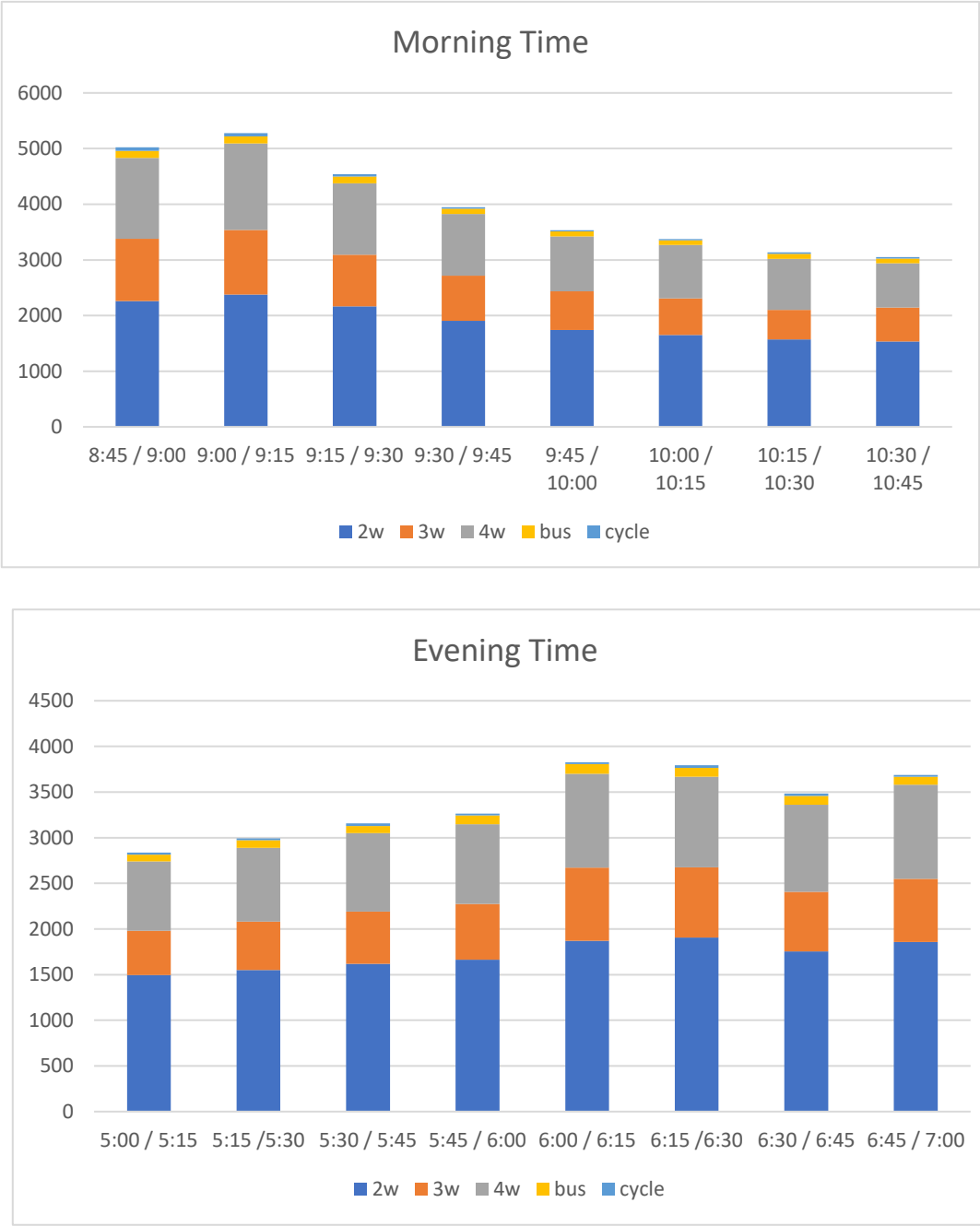


FIGURE 3.25 VEHICLES COMPOSITION AT MORNING AND EVENING TIME (NARODA JUNCTION)

Above all given figures suggest number of different types of vehicles like 2w,3w,4w etc. in peak hours of morning and evening with 15 minutes of interval. It can be observed that in morning 9:15 to 9:30 am there is maximum number of vehicles composition and in evening 6:00 to 6:15

maximum vehicle composition is observed. It is mainly due to the area covered around the site.

3.11 NAROL JUNCTION

3.11.1 BACKGROUND

FIGURE 3.26 NAROL JUNCTION

Narol junction located is in Eastern part of Ahmedabad. Vatva GIDC one of the largest industrial estate and outstanding road connectivity with Narol junction. Narol junction is surrounded by some area like Piplaj, Isanpur, Vatva, Maninagar, and Kamod. Narol junction is connect with NH8 and another side connect with Narol - Sarkhej road. One can easily reach Vatva Railway Station via Narol – Vatva road which is around 4 km away. Through riverfront road, Sardar Vallabhbhai Patel International Airport is located at a distance of 19 km from Narol junction. Narol junction is one of the largest

junctions of Ahmedabad. Narol junction is one of the entry points of the Ahmedabad. Narol junction near all area most commercial and industrial area.

1.2 km stretch from Narol to Naroda flyover bridge has strong presence of both residential and commercial area dominated by industries on either side of the road. Below the flyover Narolgam junction is a four-arm junction which hosts mixed land use. A 58 m wide rotary though which BRTS corridor is also running.

Total Fatalities: 16 (2019)

Affected mode: 8 TW and 4 Pedestrian 3 car 1 Truck.

Responsive mode: 2w, 4w and BRTS

3.11.2 ISSUES IDENTIFIED

- Excessive peak hour traffic
- Blind spots over the bridge
- Bottlenecks due to narrow bridge High speed traffic
- Poor road marking and signage
- Conflicts while crossing as well as along the highway.

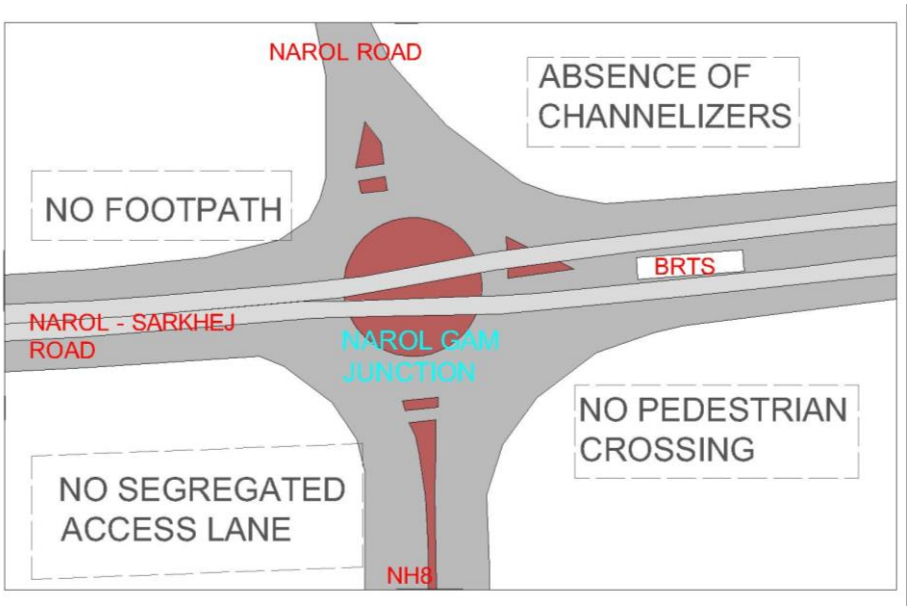


FIGURE 3.27 ISSUES OF NAROL JUNCTION

3.12 Data collection of Narol junction

Data for a pedestrian count and vehicle count was done through manual counting, whole intersection measured manually. All these surveys were done in the peak hours. The pedestrian data collection period accurate during the morning peak period (8:45 am – 11:15 am) and evening peak period (5:00 pm – 7:00 pm) on Friday June 11,2021 and the two-hour assigned period was divided into eight intervals for ease of counting.

3.13 Pedestrian Analyses Narol Junction

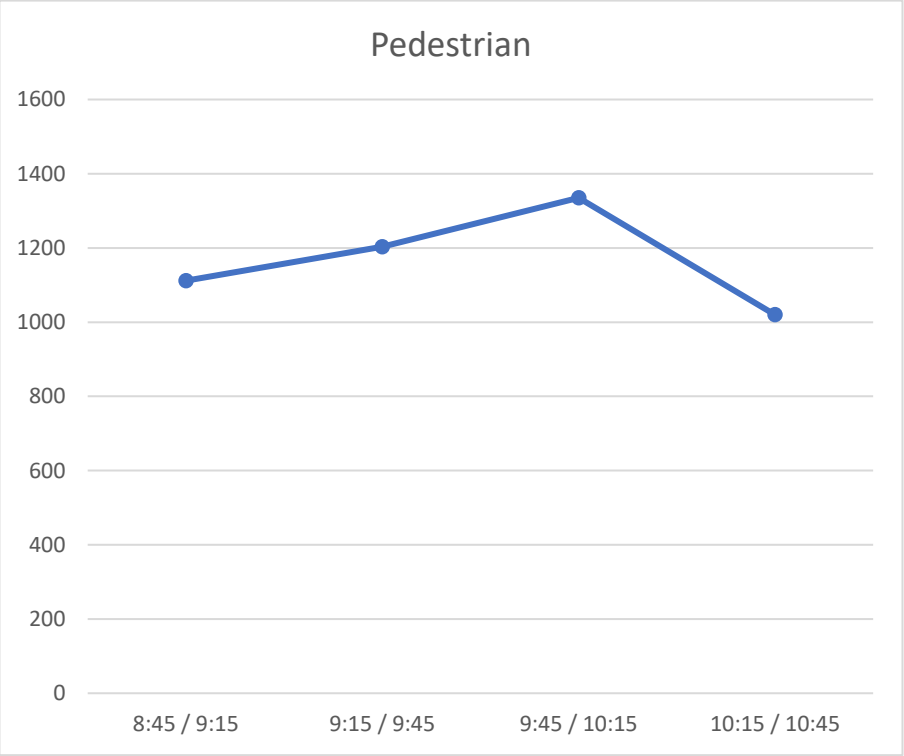


FIGURE 3.28 PEDESTRIAN TRAFFIC MORNING TIME (NARODA JUNCTION)

Morning peak hour are from 9:45am to 10:15 am During evening the number of pedestrians crossing the road is higher. Because the area around Narol junction is industrial and commercial so at this time in the morning as they are coming to work there.

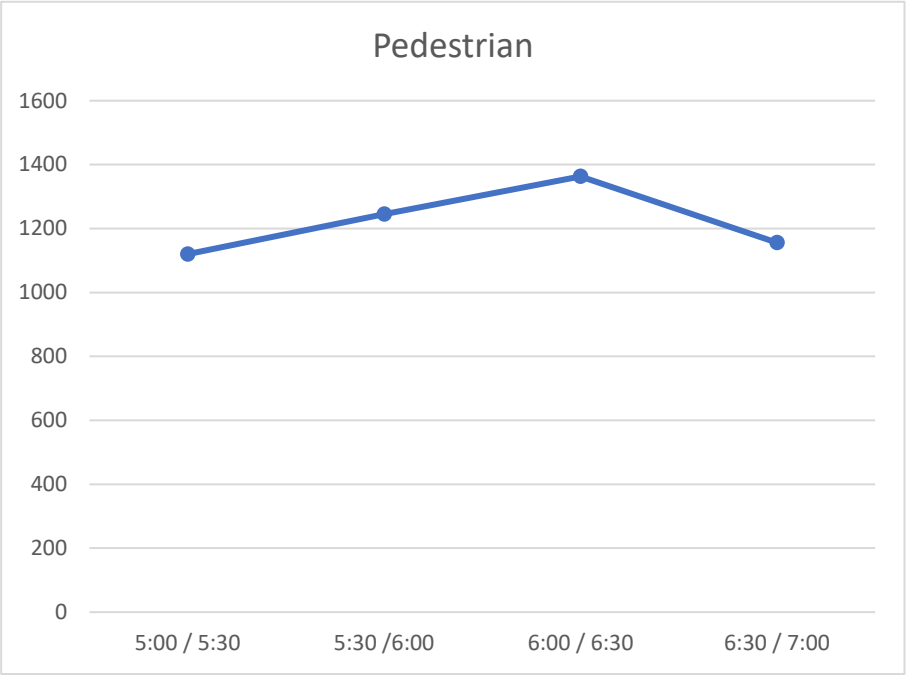


FIGURE 3.29 PEDESTRIAN TRAFFIC EVENING TIME (NAROL JUNCTION)

Evening peak hour are from 6:00pm to 6:30pm. During evening, the number of pedestrians crossing the road is higher. Because during evening

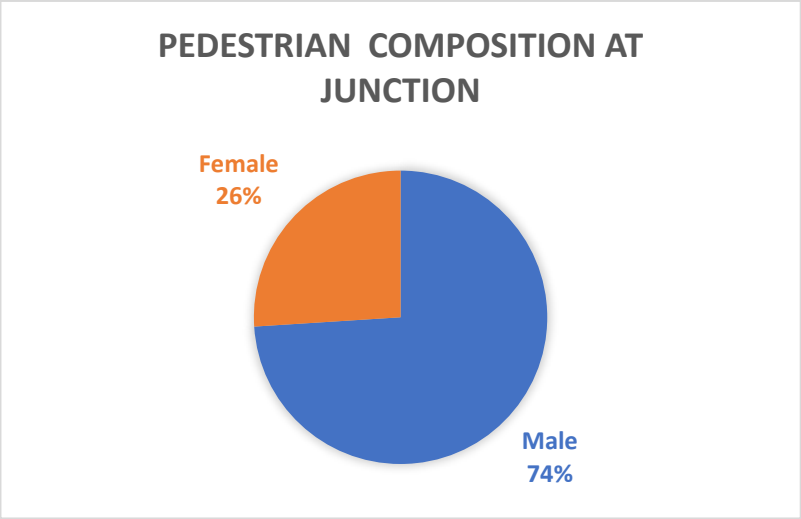


FIGURE 3.30 PEDESRIAN COMPOSITION (NAROL JUNCTION)

time shops and restaurants attracts the people beside this government approach to their home as its office closing time.

The number of males in the pedestrian is more because there is GIDC and shop near the junction most of the male work there so the number of females is less.

It is observed that there is no pattern in the moment of pedestrians. Pedestrian did not obey the rule and the just cause the road stochastically. In our observation we found that 67% of people did not follow the traffic rule.

3.14 Vehicle Analysis

3.14.1 Vehicle type

2w: Scooter/motorcycle
3w: Auto Rickshaw
4w: car/van/jeep
Bus: bus/mini bus

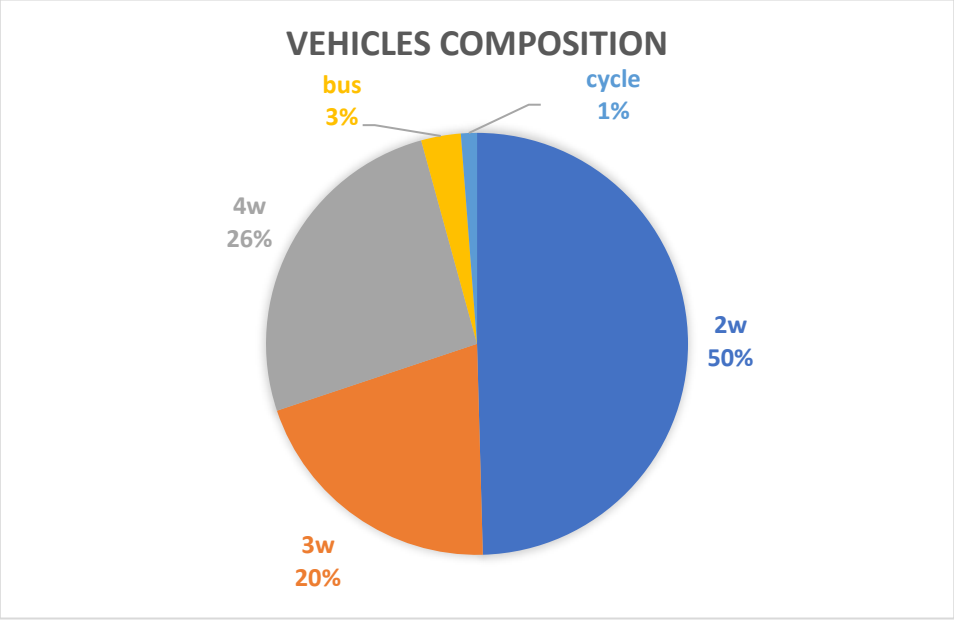


FIGURE 3.31VEHICLE COMPOSITION (NAROL JUNCTION)

3.14.2Phase plan at 15 minutes interval morning time

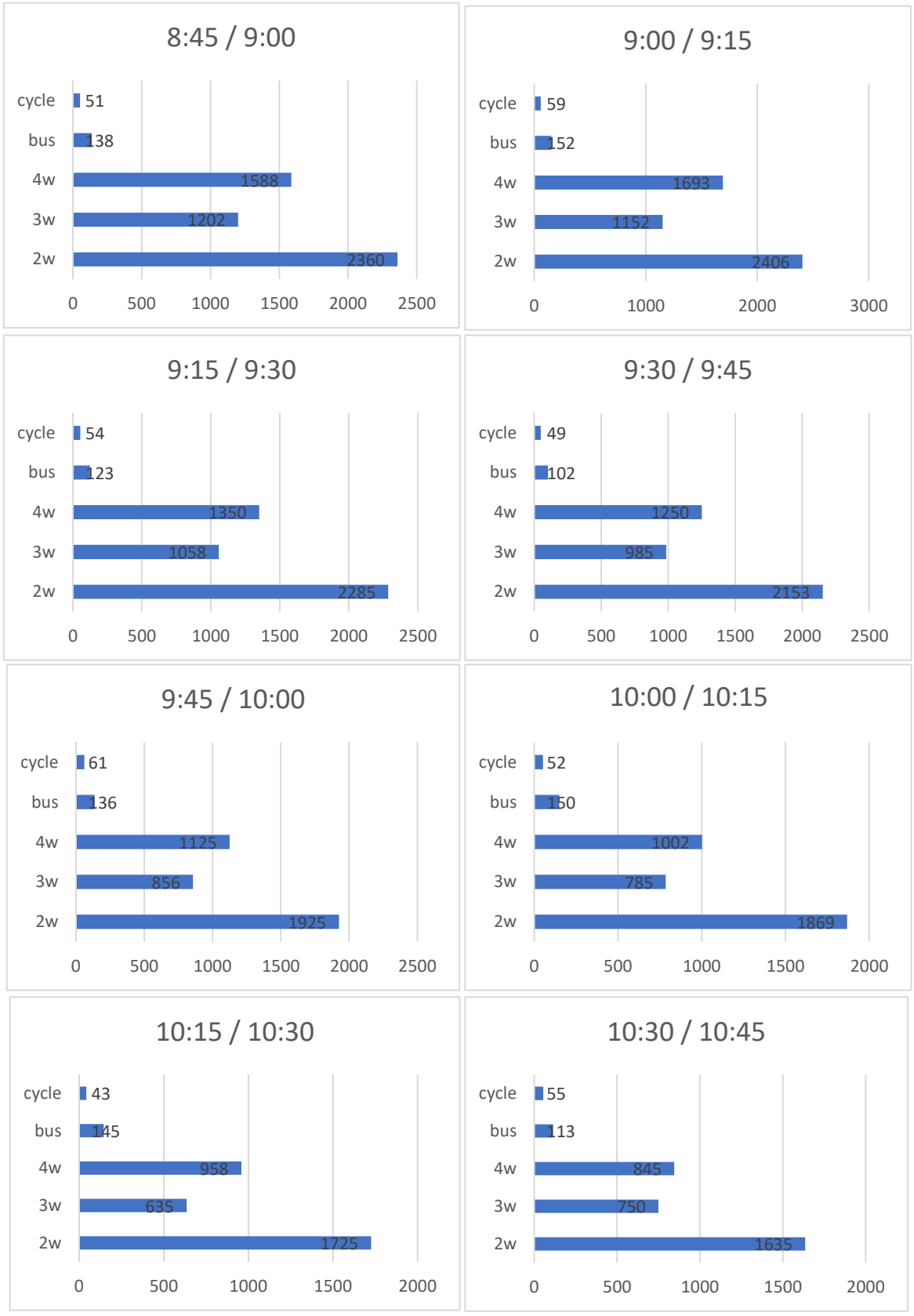


FIGURE 3.32 VEHICLE COMPOSITION PLAN AT 15 MINUTES INTERVALE (MORNING TIME) (NAROL JUNCTION)

3.14.3 Phase plan at 15 minutes interval evening time

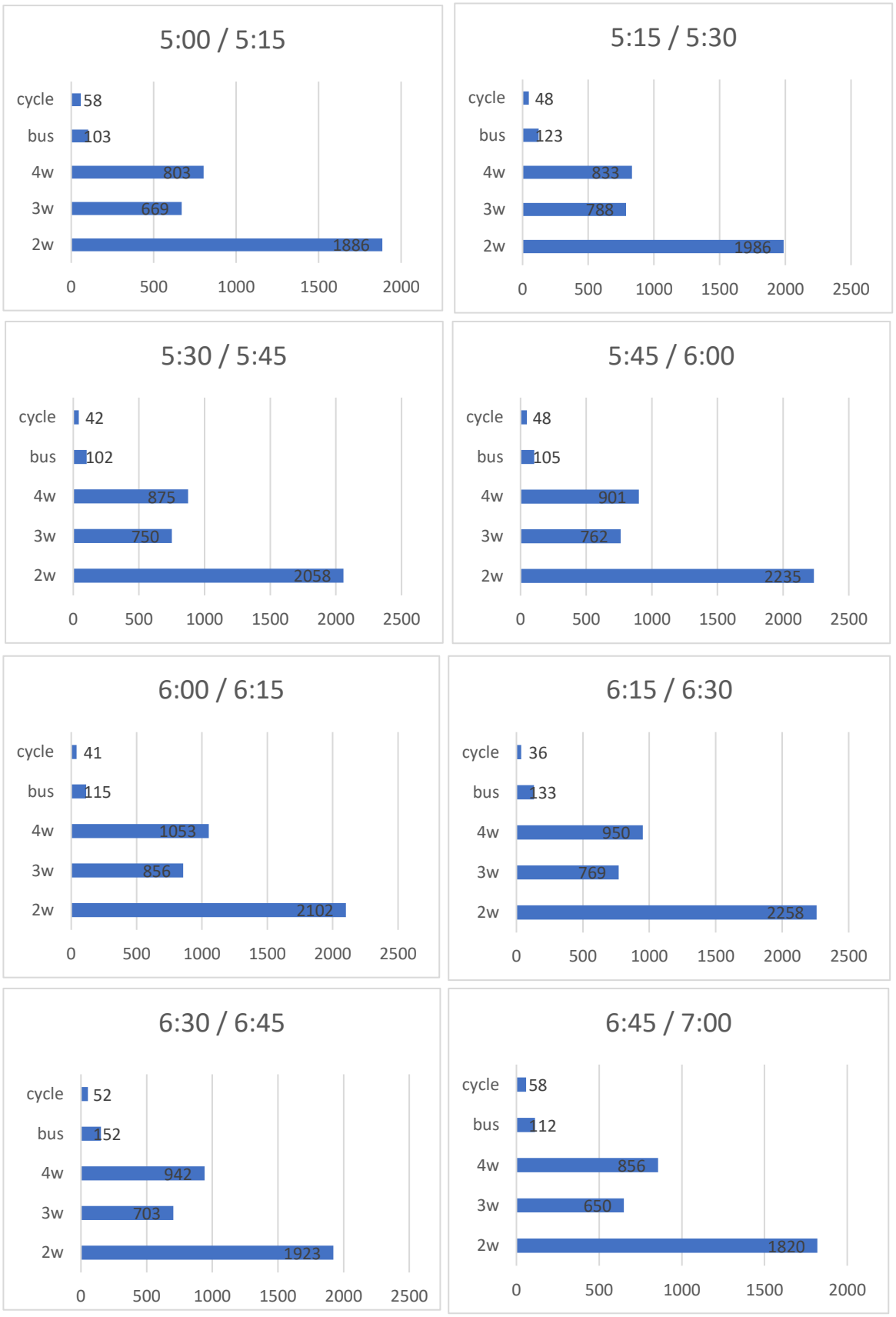
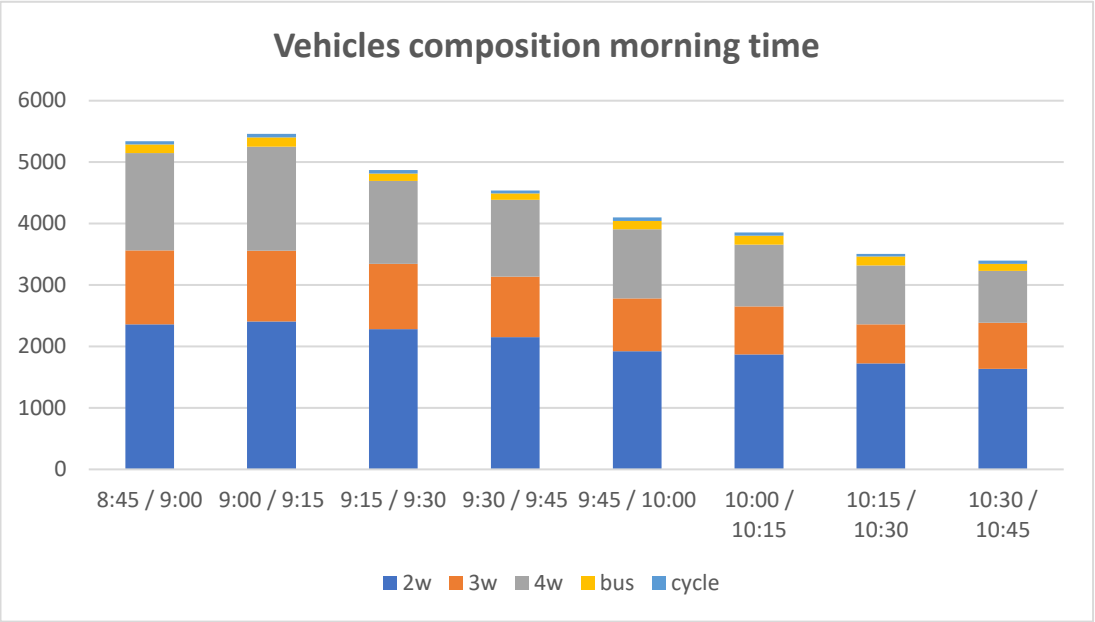


FIGURE 3.33 VEHICLE COMPOSITION PHASE PLAN AT 15 MINUTES INTERVALE (EVENING TIME) (NAROL JUNCTION)



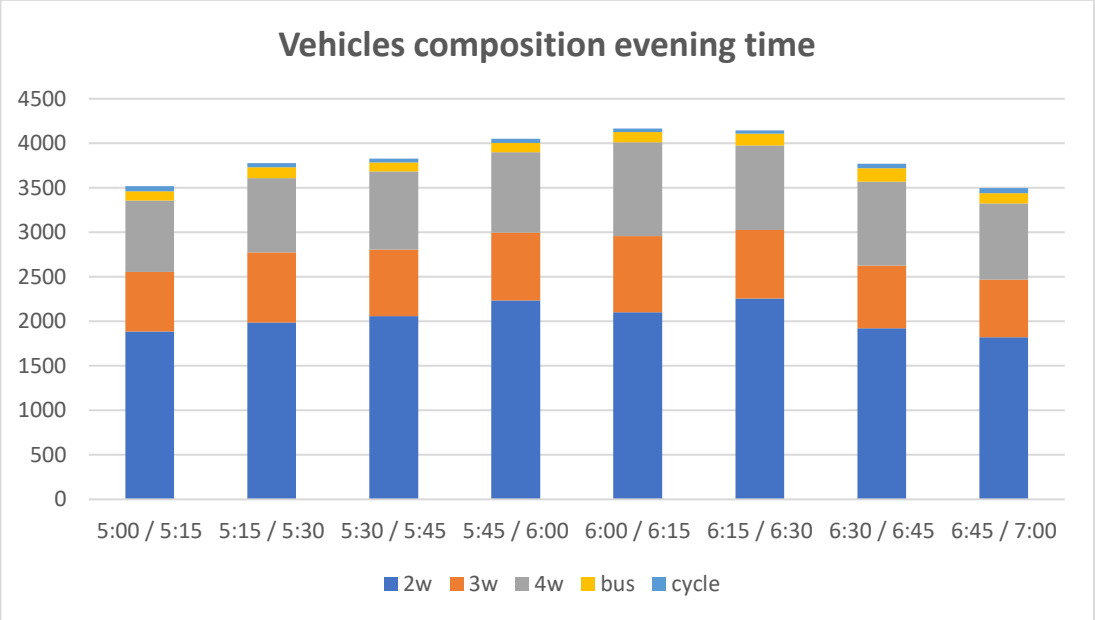


FIGURE 3.34 VEHICLES COMPOSITION AT MORNING AND EVENING TIME (NAROL JUNCTION)

Above all given figures suggest number of different types of vehicles like 2w,3w,4w etc. in peak hours of morning and evening with 15 minutes of interval. It can be observed that in morning 9:00 to 9:15 am there is maximum number of vehicles composition and in evening 6:00 to 6:30 maximum vehicle composition is observed. It is mainly due to the area covered around the site.

3.15 PUC COUNT AT NARODA JUNCTION

FIGURE 3.35 PUC COUNT AT NARODA JUNCTION POINT

A		B		C		D	
MORNING		MORNIMG		MORNING		MORNING	
TIME	P.C.U	TIME	P.C.U	TIME	P.C.U	TIME	P.C.U
8:45-9:45	2192.2	8:45-9:45	2129.5	8:45-9:45	2035.5	8:45-9:45	1286.7
9:45-10:15	1588.7	9:45-10:15	1491	9:45-10:15	1402.2	9:45-10:15	776.7
EVENING		EVENING		EVENING		EVENING	
TIME	P.C.U	TIME	P.C.U	TIME	P.C.U	TIME	P.C.U
5:00-6:00	1402.2	5:00-6:00	1323.2	5:00-6:00	1208.2	5:00-6:00	1129.5
6:00-7:00	1606.5	6:00-7:00	1563.7	6:00-7:00	1514	6:00-7:00	1240.2

TABLE 3-4 PUC COUNT AT NARODA JUNCTION

3.16 PUC COUNT AT NAROL JUNCTION

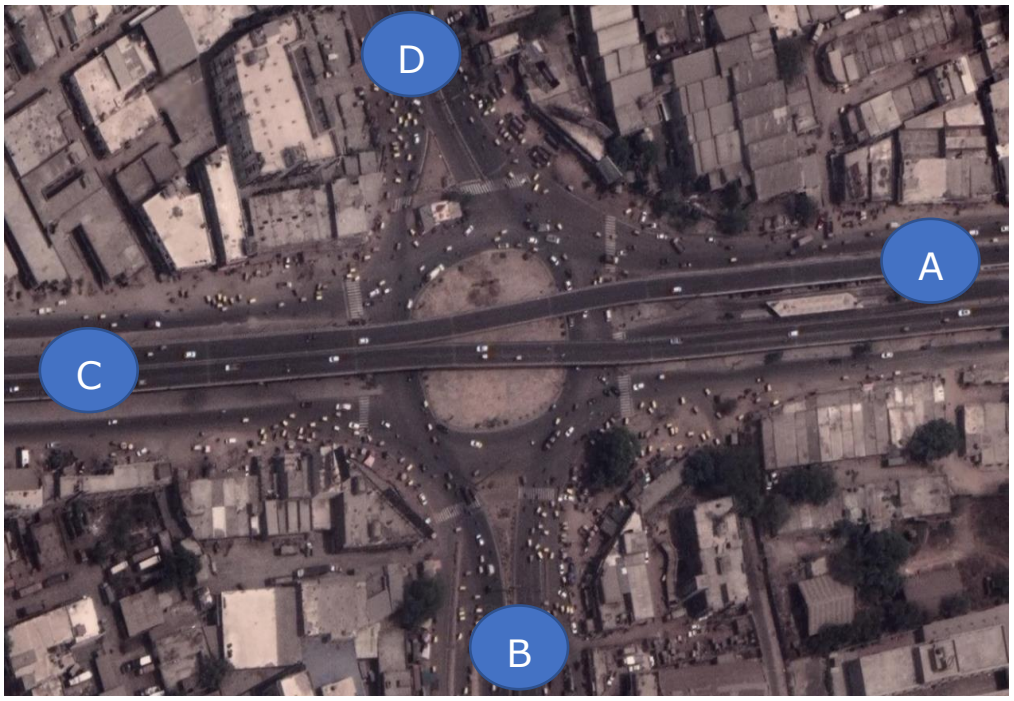


FIGURE 3.36 PUC COUNT AT NAROL JUNCTION POINT

A		B		C		D	
MORNING		MORNIMG		MORNING		MORNING	
TIME	P.C.U	TIME	P.C.U	TIME	P.C.U	TIME	P.C.U
8:45-9:45	2003.5	8:45-9:45	2301	8:45-9:45	1921	8:45-9:45	2042.5
9:45-10:15	1603.5	9:45-10:15	1517	9:45-10:15	1434.5	9:45-10:15	1616.2
EVENING		EVENING		EVENING		EVENING	
TIME	P.C.U	TIME	P.C.U	TIME	P.C.U	TIME	P.C.U
5:00-6:00	1547.2	5:00-6:00	1521.5	5:00-6:00	1442.2	5:00-6:00	1442.2
6:00-7:00	1532.7	6:00-7:00	1570	6:00-7:00	1366	6:00-7:00	1561.7

TABLE 3-5 PUC COUNT AT NAROL JUNCTION

3.17 USE OF VISSIM SOFTWARE AND FINDING THE CONFLICT POINT

Simulation should be done using VISSIM software. Simulation is done easily with VISSIM software. VISSIM software is developed by PTV group. With the help of VISSIM software we will make conflict point of Naroda junction and Narol junction.

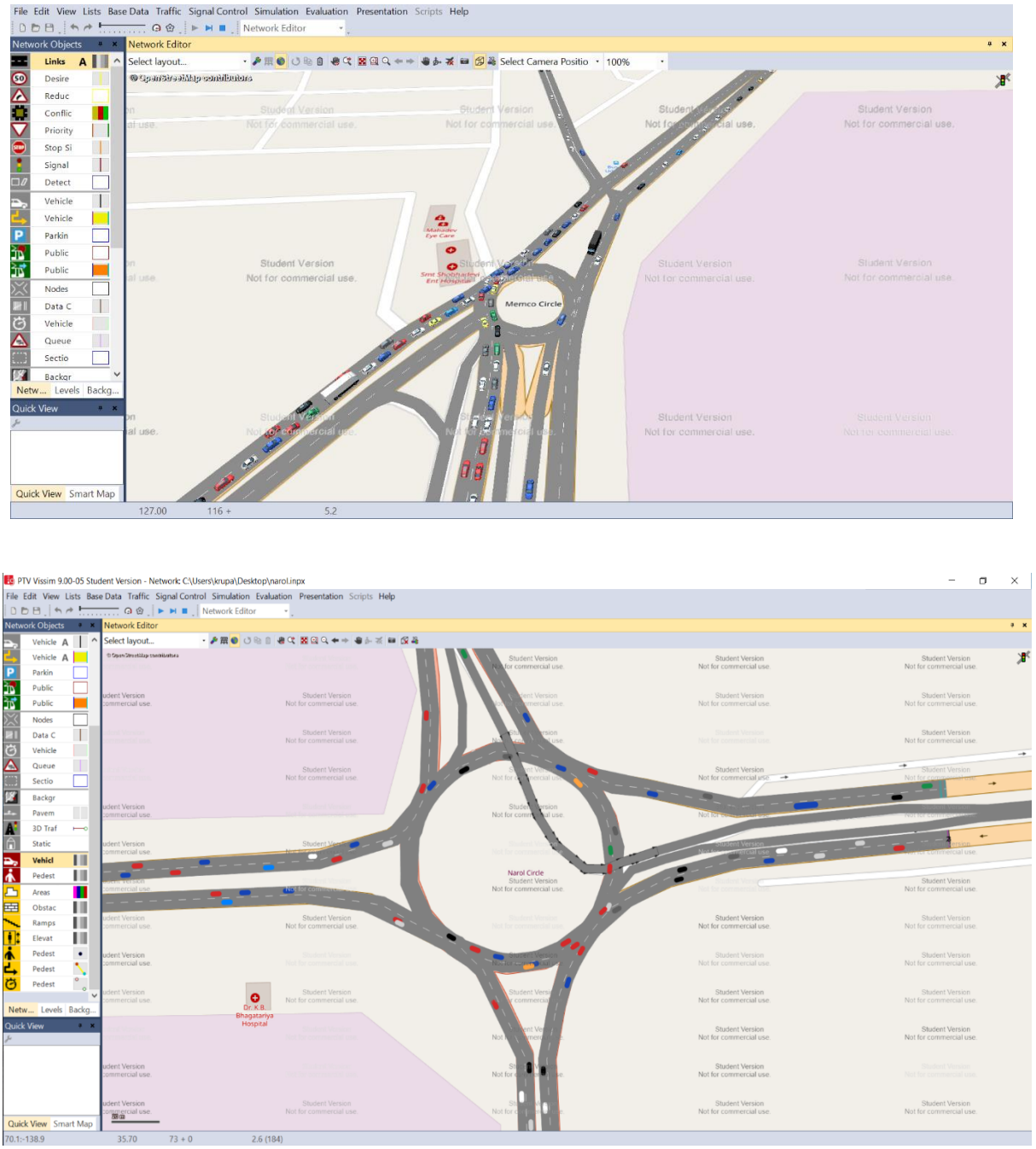


FIGURE 3.37 SIMULATION RUN

Above give figure 46 and 47 the point of junction of the junction. Given these conflicting points, we can create a new design that reduces traffic at the junction and makes the junction pedestrian friendly.

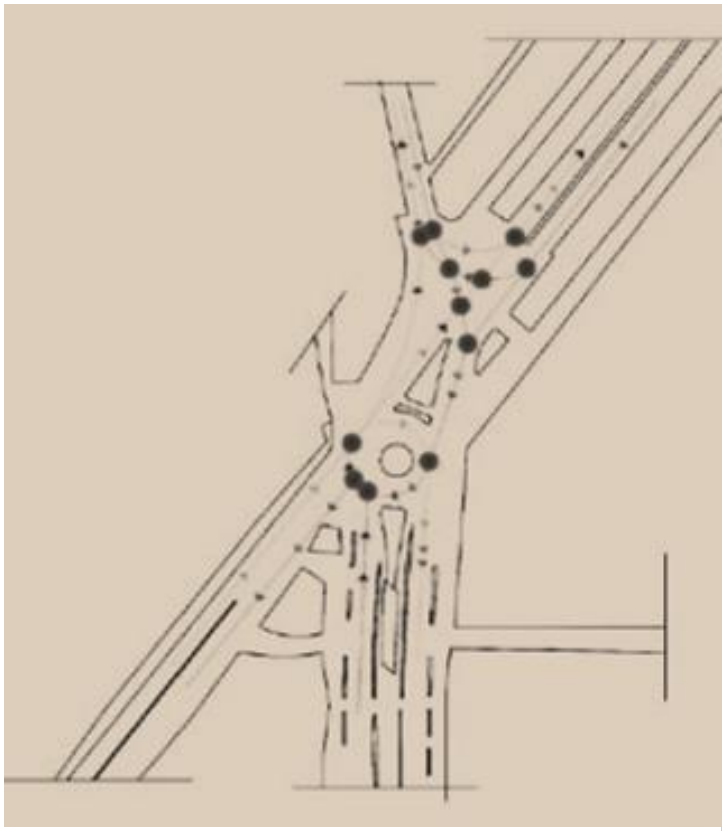


FIGURE 3.39 CONFLICT POINT OF NARODA

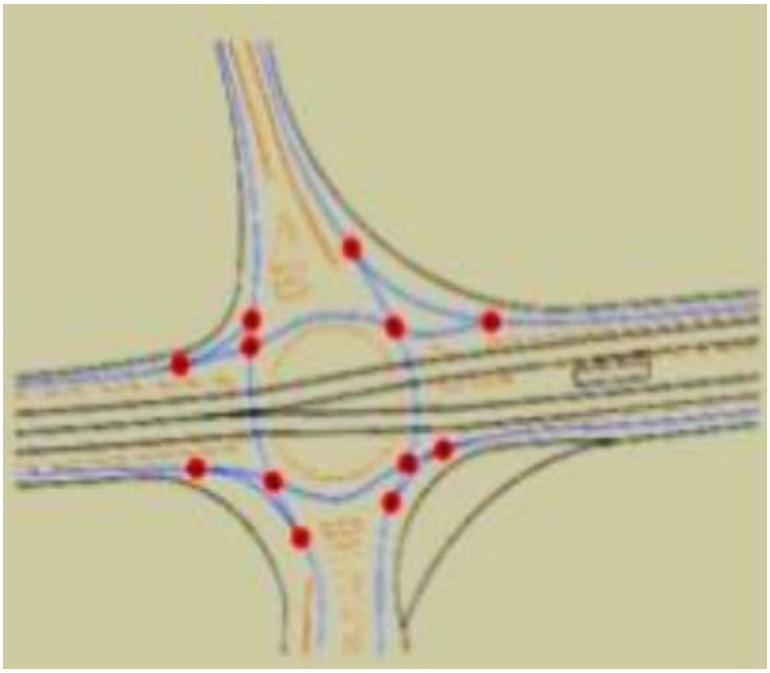


FIGURE 3.38 CONFLICT POINT OF NAROL

3.18 REDESIGN OF NARODA PATIYA CIRCLE

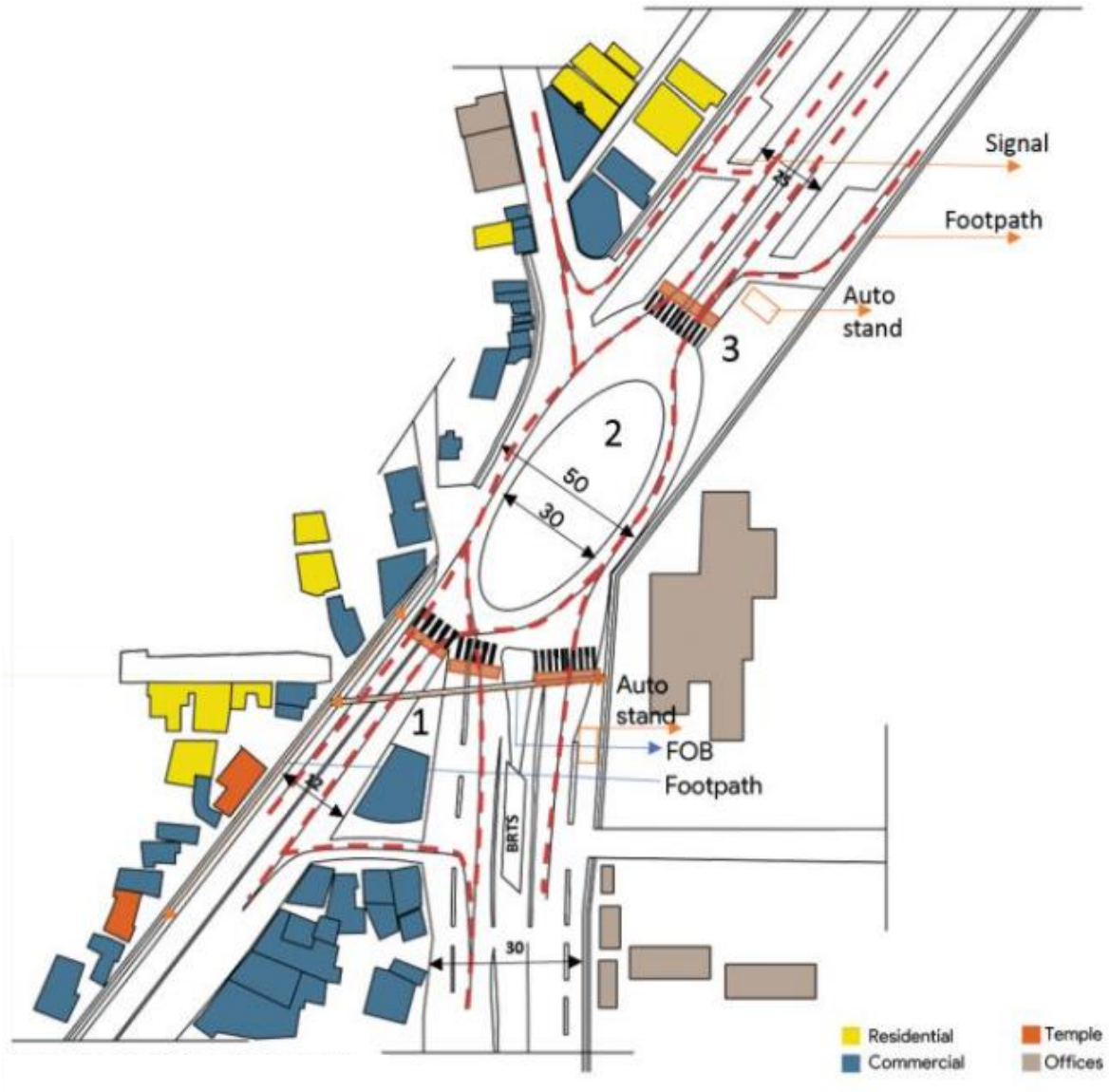


FIGURE 3.40 REDESIGN OF NARODA JUNCTION

While designing the Naroda Patiya Junction, have been made keeping in view the observations problem and the conflict point of contention. It is a complex 4- arm junction. As 14m rotary was unable to cater the junction traffic with increasing the conflict points, therefore redesigning the rotary. For making pedestrian friendly complete separated footpath with FOB crossing the junction.

3.19 REDESIGN OF NAROL CIRCLE

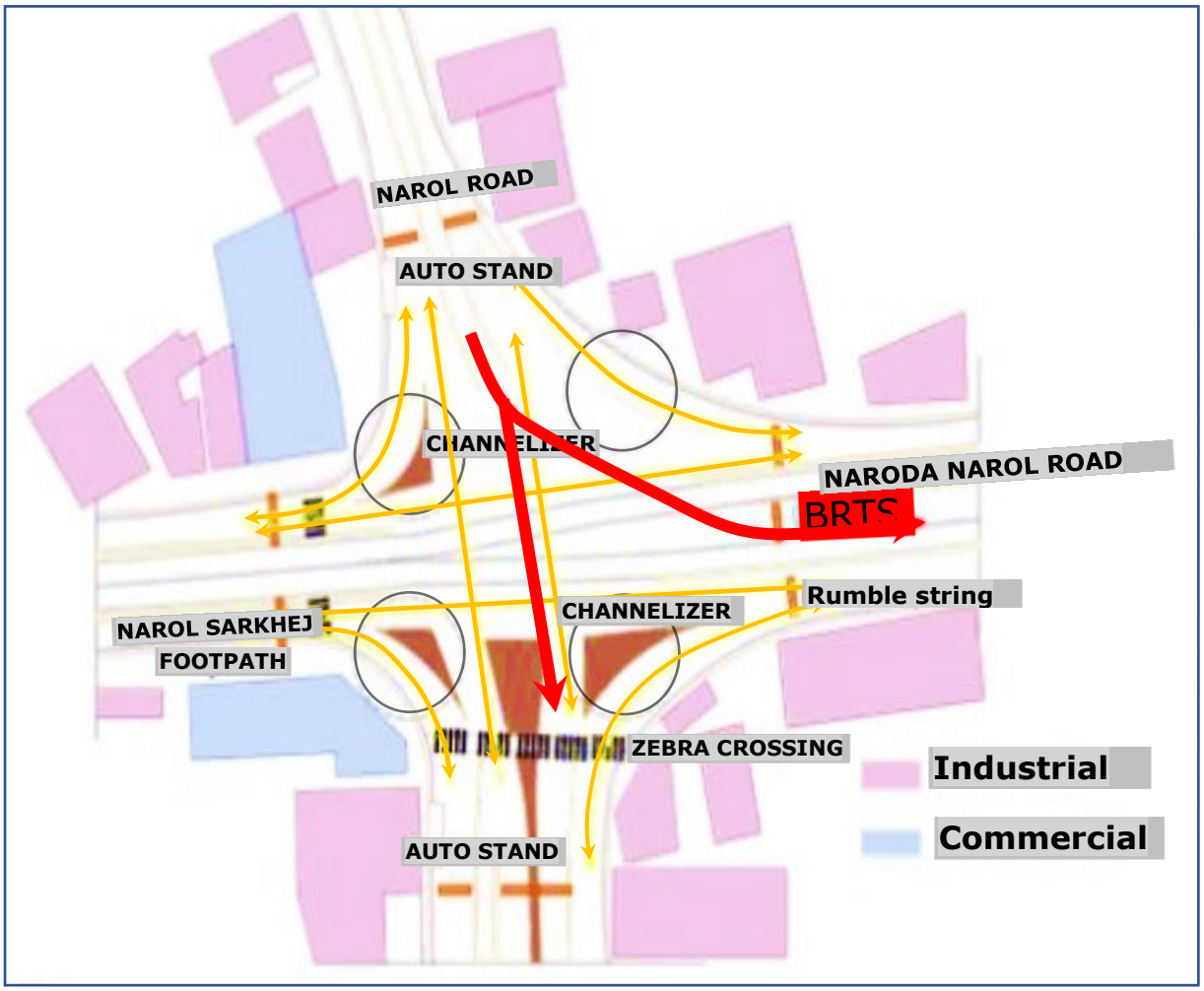


FIGURE 3.41 REDESIGN OF NAROL JUNCTION

While designing the Narol Junction, have been made keeping in view the observations problem and the conflict point of contention. The junction is re-designed by removing rotary that measures 58 m and provide signal and channelizers, thus reducing conflict points. The intersection is designed with appropriate traffic calming measures for safe mobility.

CHAPTER-4 CONCLUSION AND RECOMMENDATION

Pedestrian safety is one of the major concerns in today's world. Very less research has been done on the factors affecting pedestrian safety. Traffic factors in pedestrian fatalities are discussed in this paper. The major junctions of Ahmedabad city with high peak of traffic and more chances of accidents are considered. The data was collected through the video recording which showed that the two-wheeler vehicles and four wheeler vehicles were the responsible mode for an accident. Beside this analysis of data was simulated in VISSIM software which helped to find the points at which the crashing percentages were high for two different multiple junctions in Ahmedabad. Thus, redesigning of junction was done through AUTOCAD software by analysis of data and simulation of VISSIM software based on which the problems and recommendation are considered below.

Road inventory survey is clearly show that the actual condition of road marking, foot-path conditions etc. there is observed no markings on the road. So, there are first requirement of pedestrian is to provide proper road markings (e.g., zebra crossing) at intersection.

Traffic volume count survey indicates the actual volume of traffic on the intersection. Which is directly affects on the pedestrian movements. Based on all the pedestrian opinions and analysis, various recommendations

Awareness among pedestrians is also lacking and the development plan is such that sometimes the electricity poles and transformers are constructed beside the footpaths. The parking is being converted to footpaths due to lack of space which increases the chances of accidents. Sometimes pedestrians themselves walk on the road while crossing and do not use the zebra crossing which leads to an accident. To solve this problem the TP scheme should be planned in such a way that there is a minimal effect of the factors described above.

The study shows that the absence of a pedestrian signal phase is a major issue in Ahmedabad; thus, signalized intersections without an adequate pedestrian phase should be upgraded by implementing a special pedestrian phase with a countdown display. The presence of a signalized junction with an adequate pedestrian phase would also help in reducing path changing.

Unsignalized junctions with a high number of pedestrians–vehicular interactions should be upgraded by providing traffic signals.

For junctions where through-traffic movement is high, a suitable crossing facility for pedestrians should be constructed. The same should be done where population density is high. Furthermore, to reduce pedestrian–vehicular interaction at an intersection, flexible poles may be used to separate motorized and nonmotorized traffic.

To reduce unsafe crossing behaviour and risk-taking, marked pedestrian crosswalks (i.e., zebra crossings) must be provided at every approach to an intersection. Moreover, the pedestrian crosswalk must be well connected to the pedestrian sidewalk (i.e., footpath), which would reduce jaywalking.

As the identified speeding and overtaking tendencies are significant causes of fatal pedestrian crashes, suitable speed limit signs, speed cameras, and no-overtaking signs should be provided at the approach to a junction. In addition, vehicular speed could also be controlled with traffic-calming measures such as rumble strips, primarily at unsignalized junctions.

For superior safety management, suitable warning and road information signs should be provided near pedestrian attraction zones such as educational buildings, hospitals, heritage buildings, shopping malls, and restaurants. Additionally, a marked pedestrian crosswalk and adequate street lighting should be provided near an attraction zone.

To improve the line of sight and visibility at an intersection, the appropriate authority should remove any obstruction to sight at the intersections.

Blockage of the carriageway by on-streetcar parking and encroachment of the pedestrian sidewalk by hawkers should be prevented. Off street parking

should be provided at locations where parking demand is significant. In addition, on-street parking should not be allowed within the zone of influence of an intersection. Moreover, hawkers and street vendors (encroachers) can be shifted farther from the zone of influence of an intersection.

Pedestrian sidewalks (footpaths) must be adequately designed to improve pedestrian safety at intersections.

To reduce illegal crossing, strict and immediate enforcement of rules is required.

Police enforcement needs to be allocated to high-risk junctions (where fatal pedestrian crashes are recorded frequently).

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