بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

“In the name of Allah, the merciful and compassionate”

Congestion Mitigation and Route Design for NUST Entrance/Exit Gates

A thesis submitted in partial fulfilment of the requirements

for the degree of Bachelors of Civil Engineering

Final Year Project UG
2015

By

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School of Civil and Environmental Engineering
National University of Sciences and Technology
2019

This is to

Certify that Final year Project

Titled

Congestion Mitigation and Route Design for NUST Entrance/Exit Gates

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In

Civil Engineering

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TABLE OF CONTENTS

LIST OF FIGURES

Table **Page**

LIST OF TABLES

ACKNOWLEDGEMENT

“In the name of ALLAH, the most beneficent, the most merciful”

We wish to express our sincere gratitude and appreciation to our supervisor Engr. Malik Kamran Shakir. He provided us with best opportunities. He inspired us to make things perfect. Since the day we began our final year project, he had been there as a guiding light in each and every possible way. Without his valuable suggestions, guidance, wisdom and critical remarks our journey would not have been successful. His timely valuable suggestions, insightful discussions and encouragement throughout our project was remarkable. we owe our deep gratitude to all our Teachers for their excellent teaching skills and professional devotion that enabled us to develop craze for the subject. We obliged to Head of Department of Transportation Engineering, Dr. Muhammad Arshad Hussain for providing research facilities and student friendly environment in the department.

We wish to thanks Dr. Sameer-u-din, Engr. Malik Saqib especially for their kind help, moral support and continuous motivation during our project.

Words cannot express our feelings for the love, practical support and sacrifices of our parents throughout the long journey to achieve this goal. Last but definitely not the least, we offer our regards and blessings to all of those who supported us in any respect during the completion of this project.

Muhammad Arbaz Chohan

Abu-Bakar Siddique

Fahad Majeed

Humza Khalid

Chapter 1

INTRODUCTION

1.1 General

Traffic congestion is the condition of traffic on road networks that occurs due to excessive road use and is characterized by slower speeds, longer trip times and increased vehicular queuing. When traffic demand is great enough that the interaction between vehicles slows the speed of the traffic stream, this results in some congestion. As demand approaches the capacity of a road, extreme traffic congestion sets in. Traffic congestion can lead to drivers being frustrated and engaging in a road rage.

Traffic congestion mitigation is the process of reducing traffic congestion. This is done by using traffic calming techniques or by using Intelligent Transport System (ITS).

1.2 Problem Statement and Motivation

The main purpose of this project is to reduce traffic congestion at the entrance gates of National University of Sciences and Technology (NUST). All gates are used extensively throughout the day but longer traffic queues can be seen during peak hours i.e. in the morning from 08:00am-10:00am and 04:00pm-06:00pm in the evening.

NUST is a top ranked university in Pakistan. People from all over the country take admission every year. The delays at entrance gates during peak hours leads to drivers being frustrated and engage in road rage. The increasing level of traffic and delayed times for manual clearance at entrance gates encouraged us to work on this project. Traffic in NUST enters through three gates namely Gate-1, Gate-2 and Gate-10. Traffic through Gate-2 and Gate-10 is still cleared manually while Gate-1 is using the RFID sensors to clear the traffic as of late.

1.3 Aims and Objectives

The main objectives of this project are:

a) To analyze the performance of Gate-1 which is using the RFID sensor.
b) To provide the solution for traffic delays on other gates.
c) To identify the root cause of long queues and provide an optimum solution for it.
d) To deduce results based on our established methodology

1.4 Project Scope

The scope of the project is to analyze the E-Tag system newly implemented on Gate-1 and review the Automatic Vehicle Identification System (AVI) already emplaced. New designs for other entrance gates shall be provided in order to minimize traffic congestion. We will be able to compare the new designs with already existing designs for entrance gates and propose improvements if necessary.

LITERATURE REVIEW

2.1 Introduction

The literature review of the project is very vast and includes the main problem, its root causes and finally the solution of the given problem. The scope of research involves traffic congestion, traffic delays, traffic calming techniques and Automatic Vehicle Identification (AVI).

2.2 Traffic Congestion

Traffic congestion is a condition of traffic flow that is characterized by slow movements, longer queue lengths and greater time delays. Traffic congestion is usually the result of poor design of roadways, inadequate green time or insufficient mass transit options. With the increase in use of vehicles and automation, traffic congestion has become a serious issue in developed countries. Traffic congestion causes both physical and psychological effects on people and may lead to drivers being irritated and engage in a road rage.

2.3 Traffic Delays

A traffic delay is the additional time a driver experiences due to certain situations that causes hinderance to the desirable traffic movement. Traffic delays causes fuel to burn at a higher rate as compared to smooth traffic flow and therefore costs additional money to the drivers. They also cause air pollution because of increased emission of gases when a vehicle is standing still. A traffic jam can cause serious damage to a person or his property in case an emergency vehicle is unable to respond in required time due to traffic delay in that area.

2.4 Intelligent Transport System

Intelligent Transport System is a modern and advanced system that aims to produce innovative services regarding transportation that helps users to be safer, well informed and make smarter use of traffic.

ITS may vary in the technologies and fields in which they are used, from simple car navigation system (GPS), signal control and basic management systems to more advanced applications such as the CCTV cameras or the systems that integrate live data from a number of sources. Additionally, predictive techniques are being used to identify vehicles for faster access.

2.5 Automatic Vehicle Identification

Automatic Vehicle Identification (AVI) is an advanced application of ITS that uses predictive techniques in order to identify a vehicle. This provides a faster access to vehicles and is a safer and more reliable technique. Automatic Vehicle Monitoring involves tracking of vehicles through a point at all times. AVI can serve a broad range of purposes: to charge for road use and to improve traffic management. One of the most important use of AVI is to deal with **Traffic Congestion**.

2.5.1 Radio Frequency Identification System (RFID)

Radio Frequency Identification is the use of radio waves to read information about an object with the help of tag attached to the object. This tag contains information about the object which is stored electronically. RFID systems have two basic components; A microchip that contains the information and an antenna that receives and transmits a signal.

In transportation, the reader receives the information from the vehicle and then compares it with the database to grant access to the vehicles. This system is most reliable and more dynamic because the range for a RFID sensor is very long and it can detect objects from several meters away.

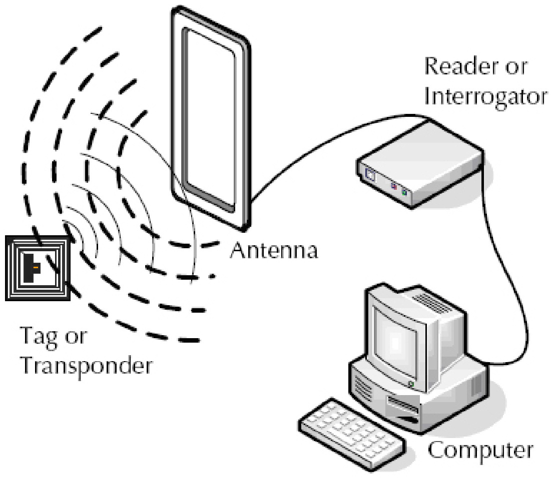


Fig. 1: RFID mechanism

2.5.2 Automatic Number Plate Recognition System (ANPR)

The Automatic Number Plate Recognition System is an AVI technique that uses Optical Character Recognition (OCR) on images in order to detect and identify the number plate of a vehicle. This technique requires a special camera that can identify the characters on the license plate and then compares it with the database stored in order to grant access to the vehicles.

ANPR provides automated access for managing and processing information of vehicle movements. This technique is not used widely because it requires a special camera and the restrictions which occur due to the heights of different vehicles.

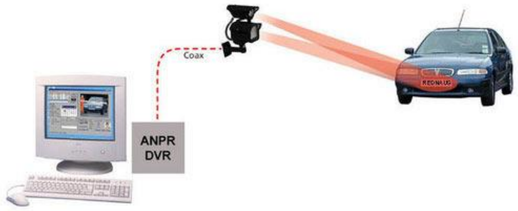


Fig. 2: ANPR mechanism

2.5.3 Barcode Recognition System

Barcode Recognition System uses a barcode decal placed in front of the vehicle in order to identify the vehicle. This barcode decal contains specific information about the vehicle. This system comprises of a barcode decal and a barcode reader. A barcode reader is a specially designed Optical Character Reader that reads the barcodes on a vehicle and compares it with the database in order to grant access to the vehicle.

This technique has become obsolete because a barcode reader cannot work properly in daylight and can produce negative results in bad weather conditions.

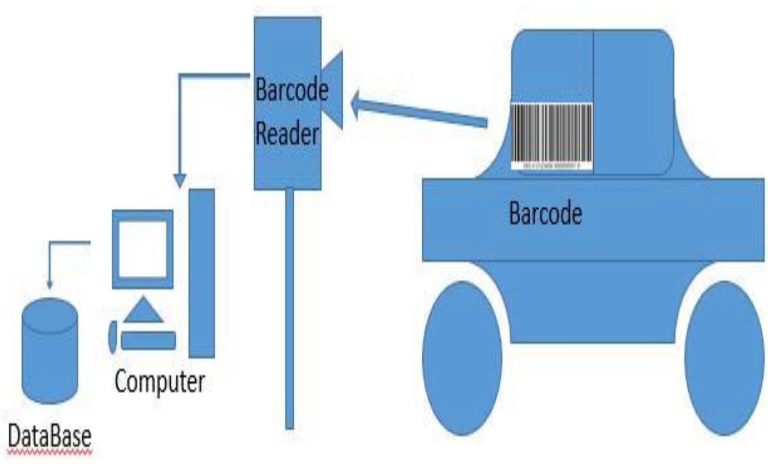


Fig. 3: Barcode Recognition mechanism

2.6 Traffic Calming Techniques

Traffic calming techniques are the strategies that helps safer, reliable and smooth traffic flow. It uses physical design and other safety measures to help improve the traffic flow.

Traffic calming techniques include lane narrowing, reducing the corner radii, building trees and islands, gateway treatments, lane shifts, roundabouts and speed humps.

RESEARCH METHODOLOGY

3.1 Introduction

A research method is a systematic plan for conducting research. Sociologists draw on a variety of both qualitative and quantitative research methods, including experiments, survey research, participant observation, and secondary data.

3.2 Data Collection

Data collection is a process of collecting information from all the relevant sources to find answers to the research problem, test the hypothesis and evaluate the outcomes.

3.2.1 Traffic Data Collection

Accuracy in traffic data collection is fundamental in that the resulting data serves as the foundation of planning for road, highway and infrastructure.

Fig. 4: Tally Marks

- **Manual Count Method**

  First of all, traffic was segregated into following classes.

  • Motor Bikes

  • Passenger Cars

  • Wagons

- **Representative Day and Time Slot**

  Traffic counts on Monday and Thursday were taken to omit any exceptional behavior of high traffic volumes. The selected time slots were

MORNING	8:00 to 10:00 AM
EVENING	4:00 to 6:00 PM

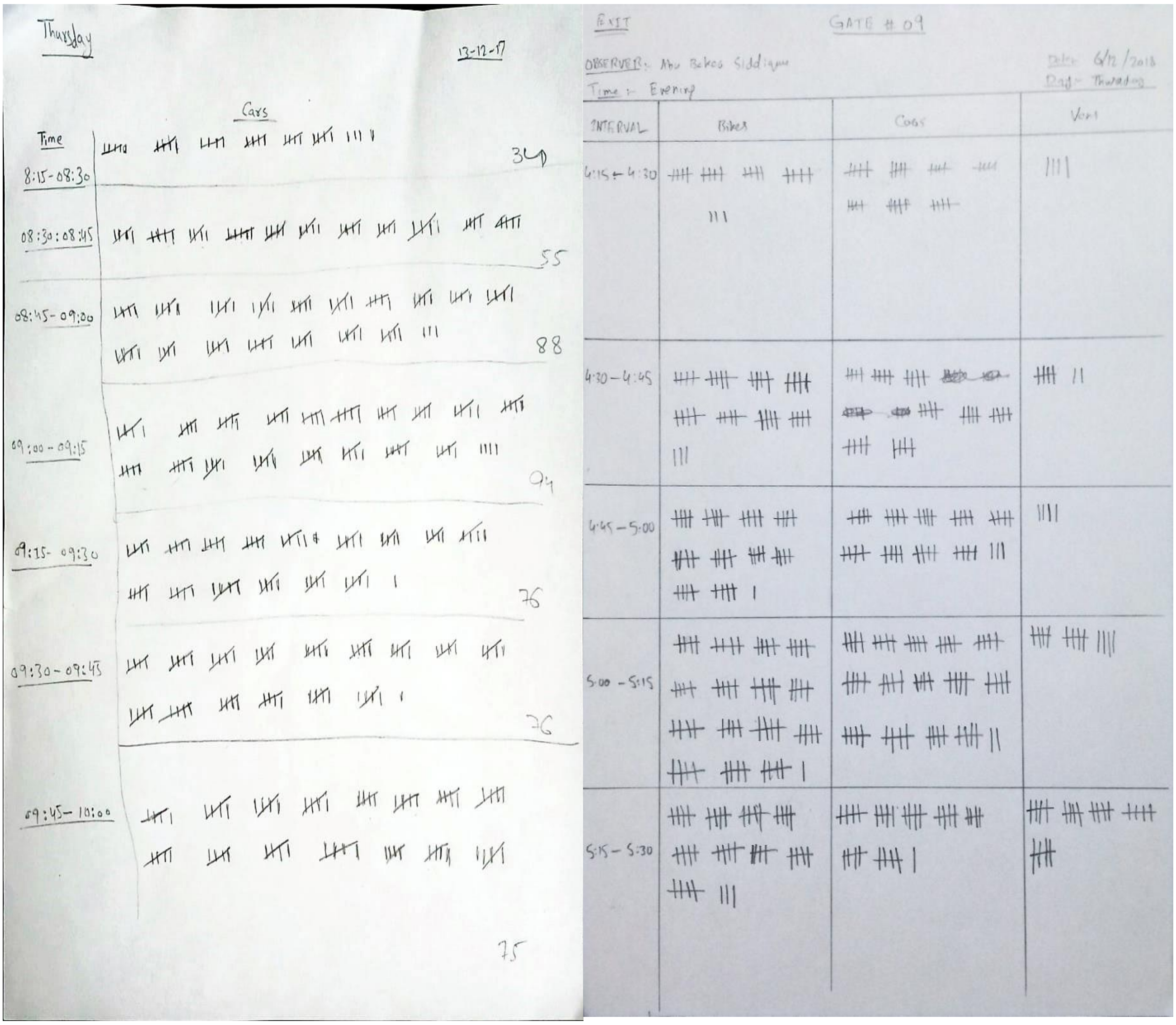


Fig. 5: Data Sheets

GATE-01

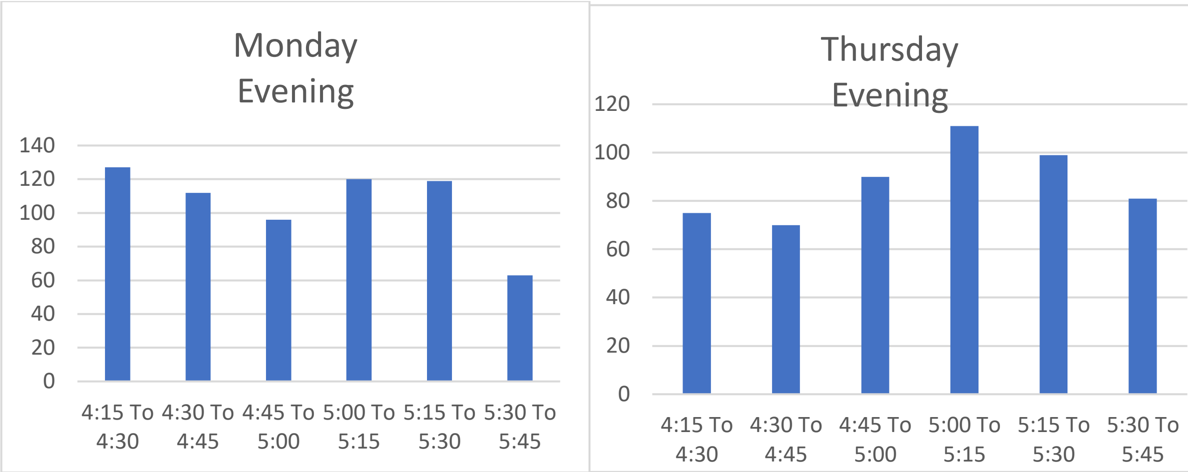


Fig. 6: Traffic count data for Gate-02

GATE-02

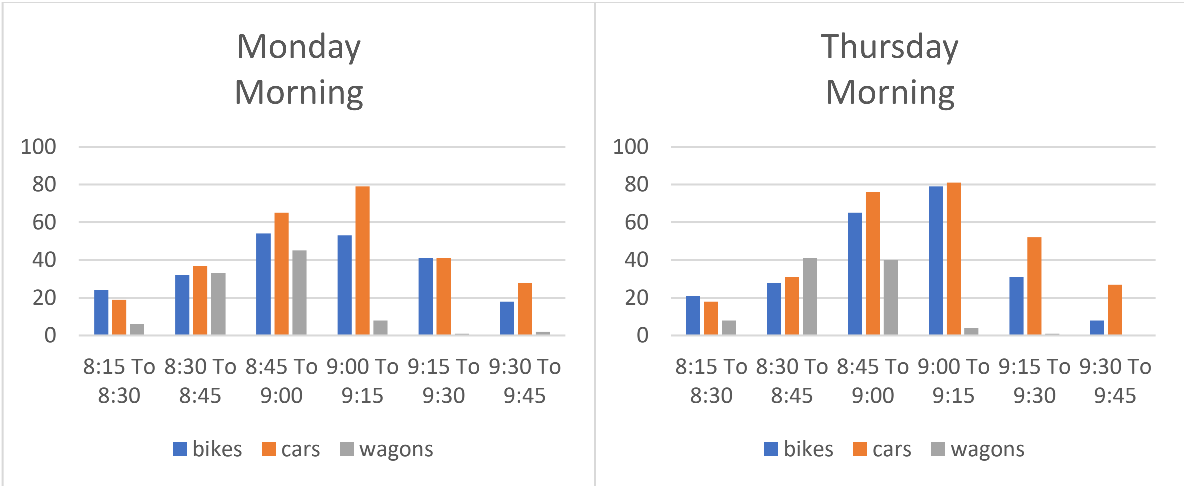


Fig. 7: Traffic count data for Gate-01

GATE-10

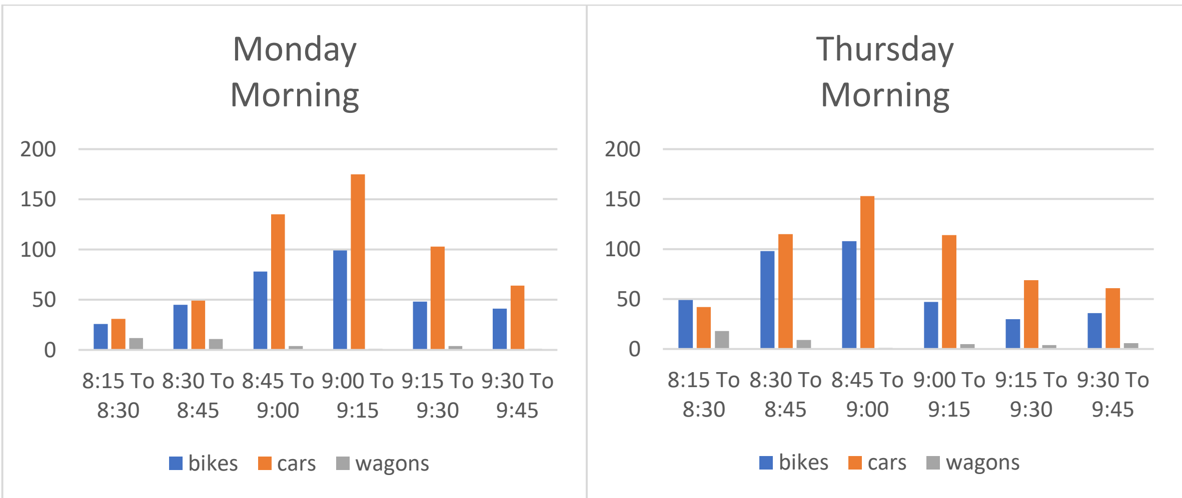


Fig. 8: Traffic count data for Gate-10

3.2.2 Geometric Conditions

The features of road and the positioning of the physical elements of the roadway according to data collected at site using measuring tape.

Table 1: Road Specifications (Existing)

Road Specifications			
	Gate-1	Gate-2	Gate-10
Lane Width	10'-0"	12'-0"	16'-0"
Median Openings	25'-0"	-	36'-0"
Footpath	8'-0"	7'-6"	8'-0"
Drainage	2'-0"	2'-0"	2'-0"
Median	9'-0"	10'-0"	20'-0"

GATE-01

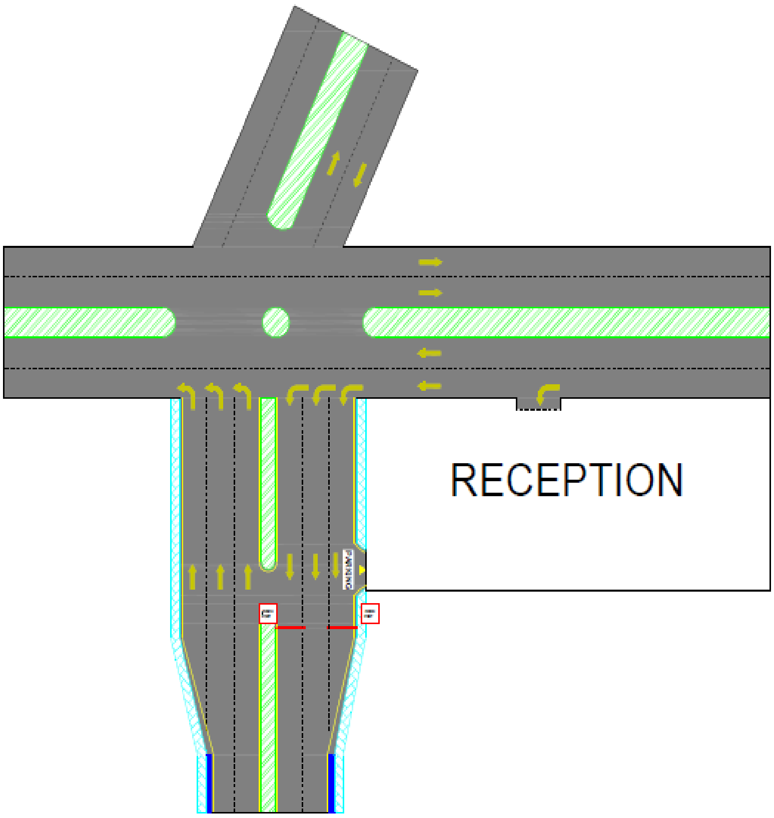


Fig. 9: Existing Gate-01 design

GATE-02

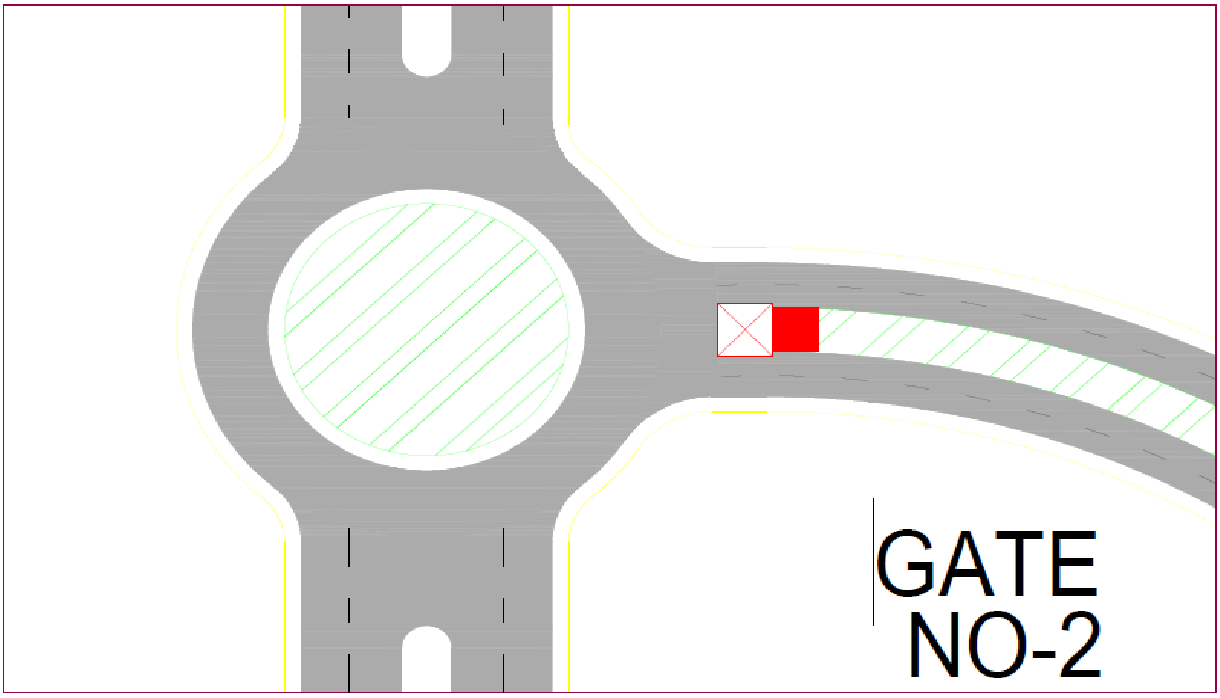


Fig. 10: Existing Gate-02 design

GATE-10

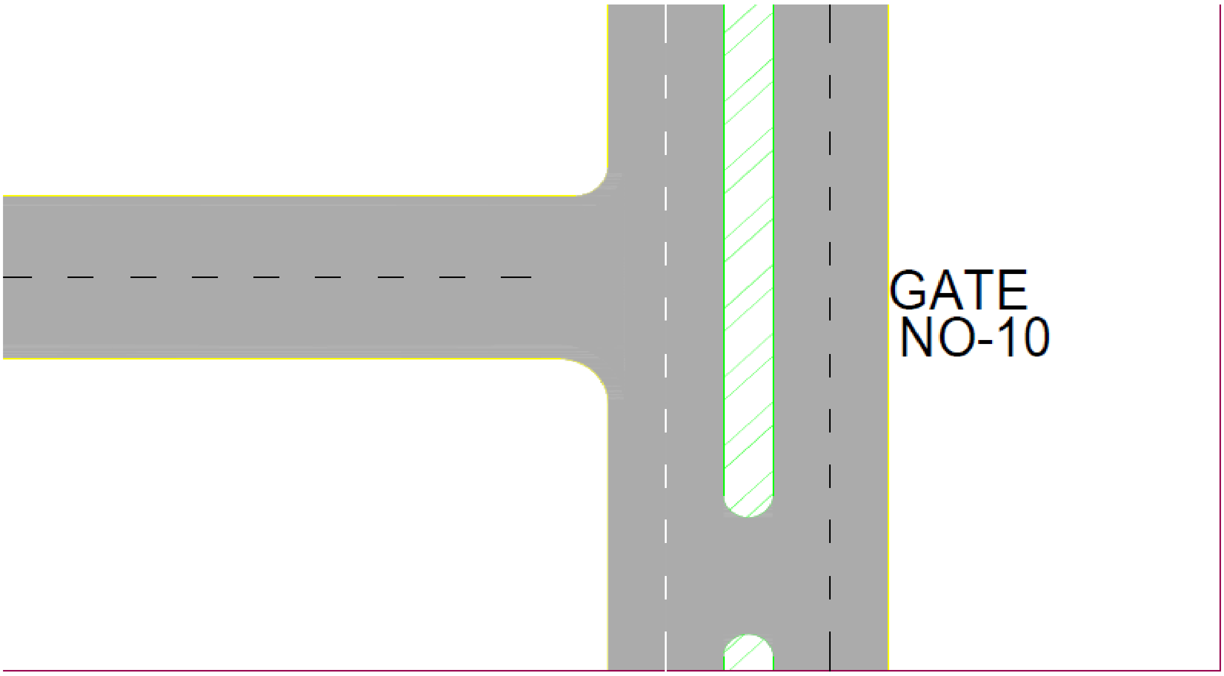


Fig. 11: Existing Gate-10 design

3.2.3 Average Delay Time Collection

Average delay time i.e. the average time taken by a vehicle for clearance was calculated using a stopwatch.

This time was estimated as **5s.**

3.3 Analysis of Traffic on Existing Gates

Queuing Systems

- **Single Server Model:**

Average Number in the System=

$$L = \frac{\lambda}{\mu - \lambda}$$

Channel Utilization= $\rho = \frac{\lambda}{\mu}$

Average Number in the Queue = $L_q = \frac{\lambda^2}{\mu(\mu-\lambda)}$

- **Multi-Server Model:**

Average Number in the System= $L_q = \frac{\lambda^2}{\mu(\mu-\lambda)}$

Channel Utilization= $\rho = \frac{\lambda}{N\mu}$

Average Number in the Queue = $L_q = \frac{P_0 \rho^{N+1}}{N!N} \left[\frac{1}{\left(1-\frac{\rho}{N}\right)^2} \right]$

Delay Calculations

- M/M/1-queue the average time of customers in the system (i.e. the waiting time) is

$$w = \frac{1}{R} = \frac{1}{c-q} = \frac{1}{c(1-x)}$$

- The average delay for the M/M/1-queue is

$$d = w - \frac{1}{c} = \frac{x}{c.(1-x)}$$

Where,

w = average waiting time	(s)
d = average delay	(s)
R = reserve capacity = c – q	(veh/s)
c = capacity	(veh/s)
q = demand volume	(veh/s)
x = degree of saturation = q/c	(-)

INTRODUCTION TO VISSIM

4.1 General

PTV VISSIM is a standard microscopic multi-modal traffic flow simulation software. This Software developed by PTV (Planung Transport Verkehr AG) in Karlsruhe, Germany in 1992. The name is derived from "Verkehr In Städten - SIMulationsmodell".

Fig. 12: PTV VISSIM

VISSIM is the world's most advanced software for the traffic simulation in Engineering field and today's a global market leader. It's been widely used by engineers because of its flexibility, accuracy and integrity. One can model demand, supply and behavior in detail. It also allows both 2D and 3D visual analysis for different complex situations. Perfect way to present conclusive and understandable planned infrastructure measures to decision-makers and the public. Also, very user-friendly software to get started with. With its key features, user can design network of any complexity.

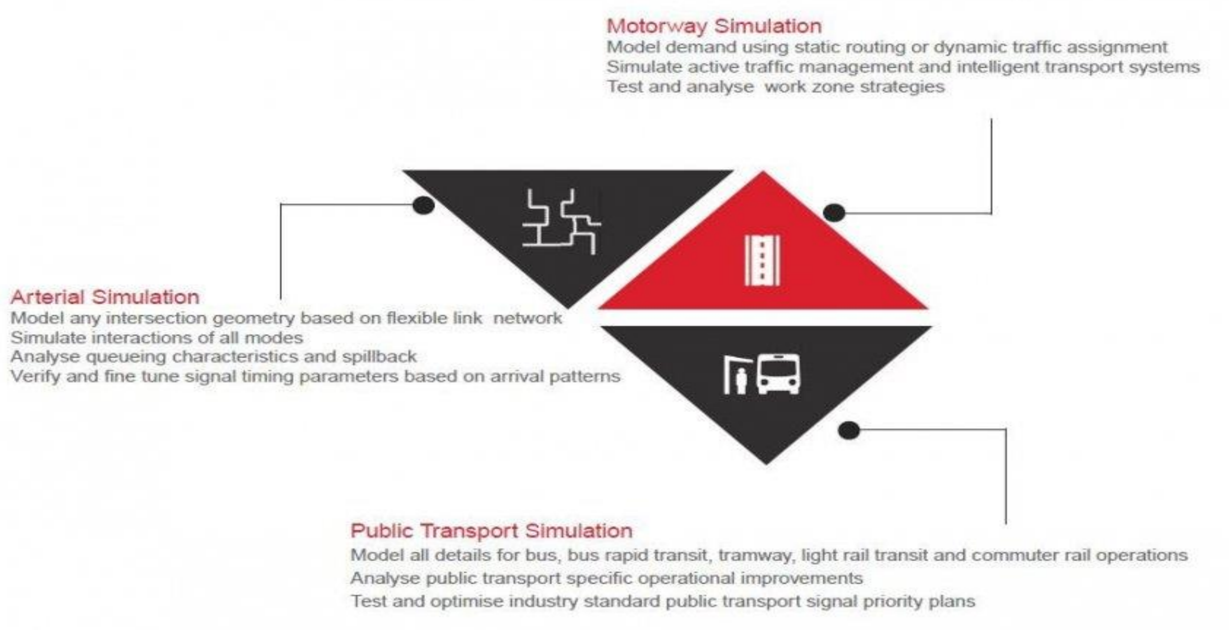


Fig. 13: Features of PTV VISSIM

Following are key features of PTV Vissim.

1. Detail and Realistic Simulation
2. Quick and Simple Set-up
3. Flexible and Seamless Integrations
4. Strong Network and Support

You can integrate this software with others for more details because of strong support provided by PTV e.g.

1. PTV Viswalk
2. PTV Vistro
3. PTV Optima
4. PTV Balance
5. PTV Epics
6. PTV Vistad
7. PTV Visum Data Analytics

4.2 Getting Started

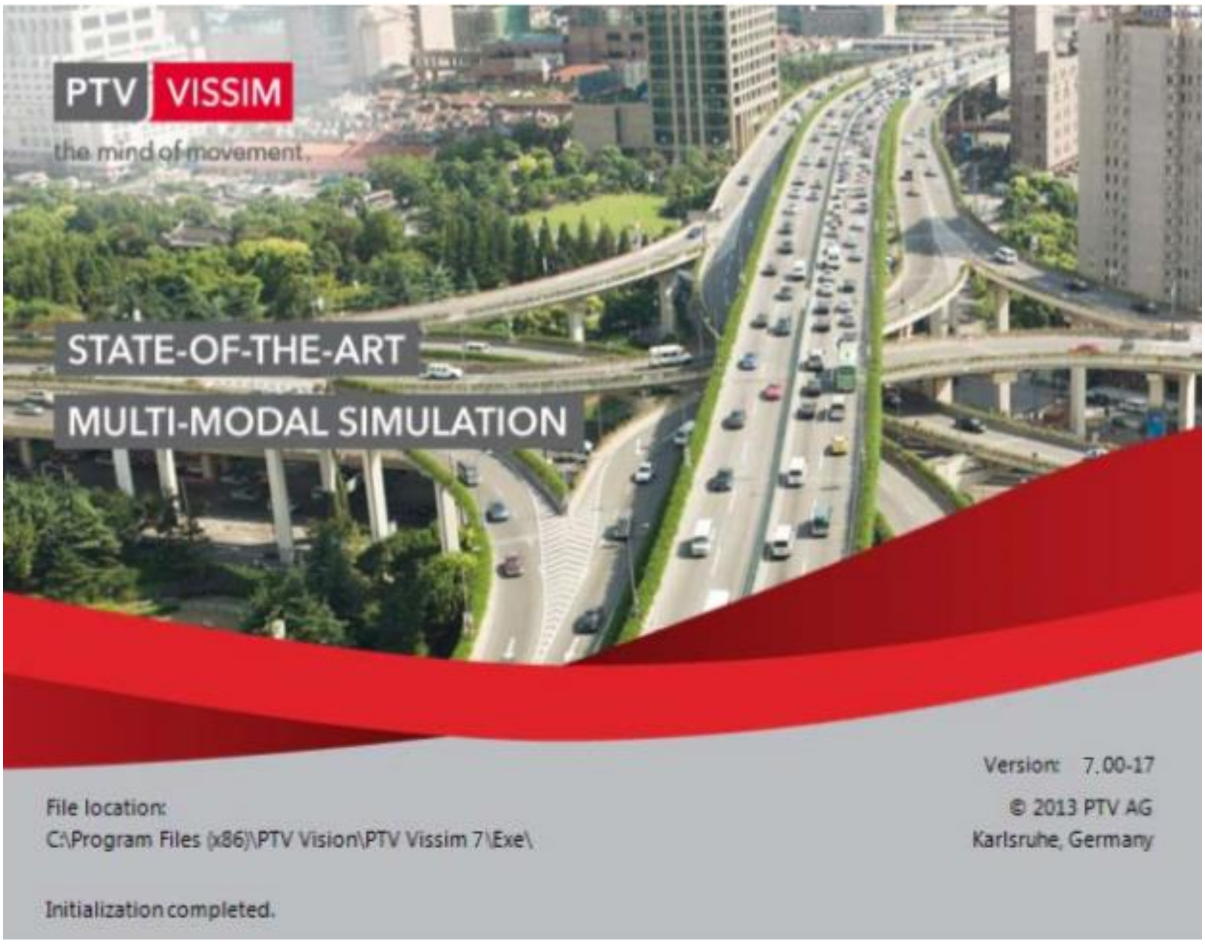


Fig. 14: PTV VISSIM getting started

4.2.1 General Settings

When Start the Vissim for the first time, a dialogue box will prompt on the screen. Vissim will ask to confirm your right click behavior. You can Change it later any time.

Go to **Edit** > **User Preferences**

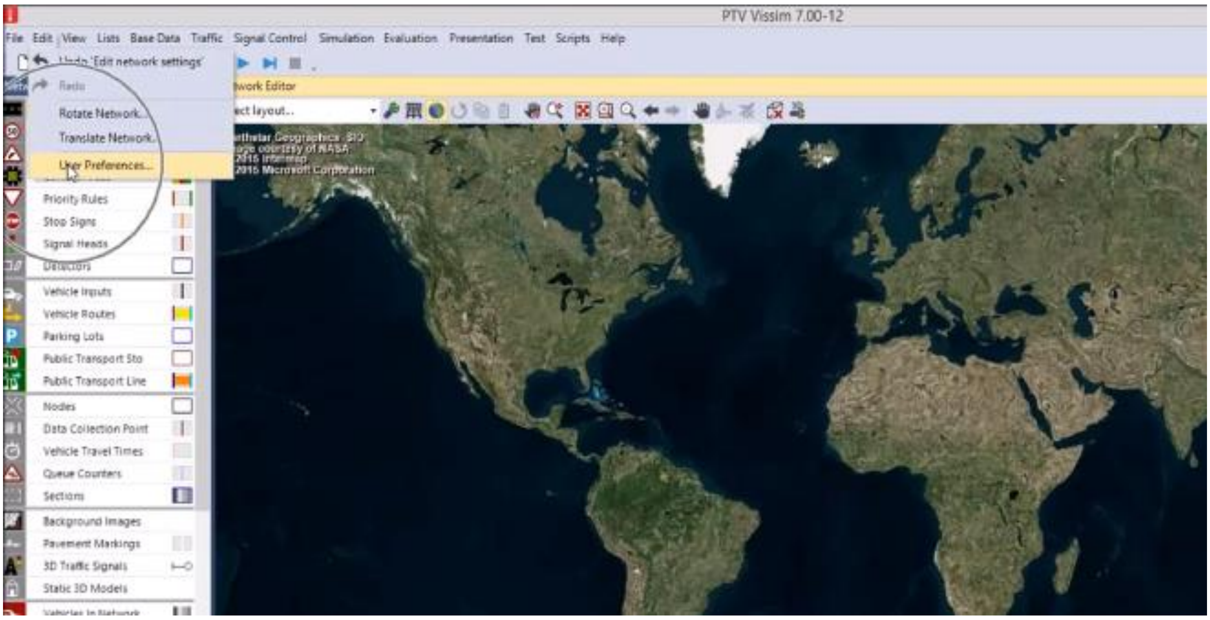


Fig. 15: PTV VISSIM user preference

Select the **Network editor** and you can change right click behavior.

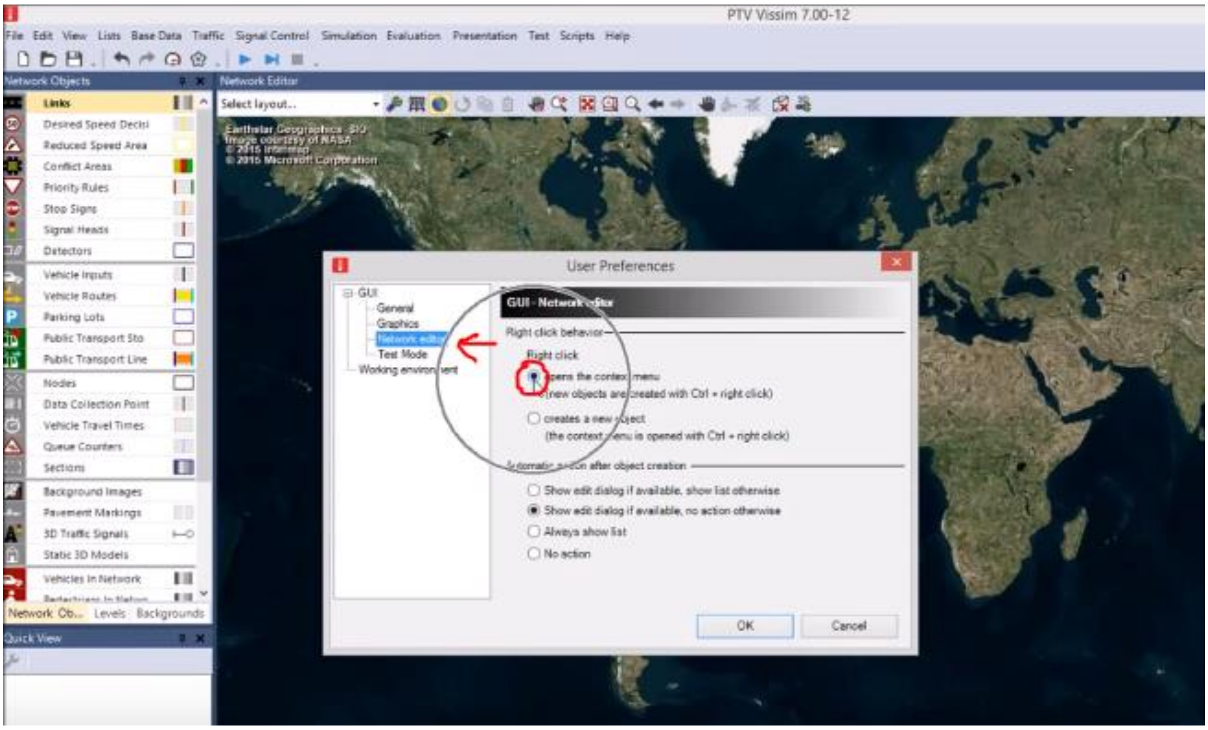


Fig. 16: PTV VISSIM network editor

First step when starting the Vissim is to set your network settings.

Go to **Base Data** >> **Network Settings**

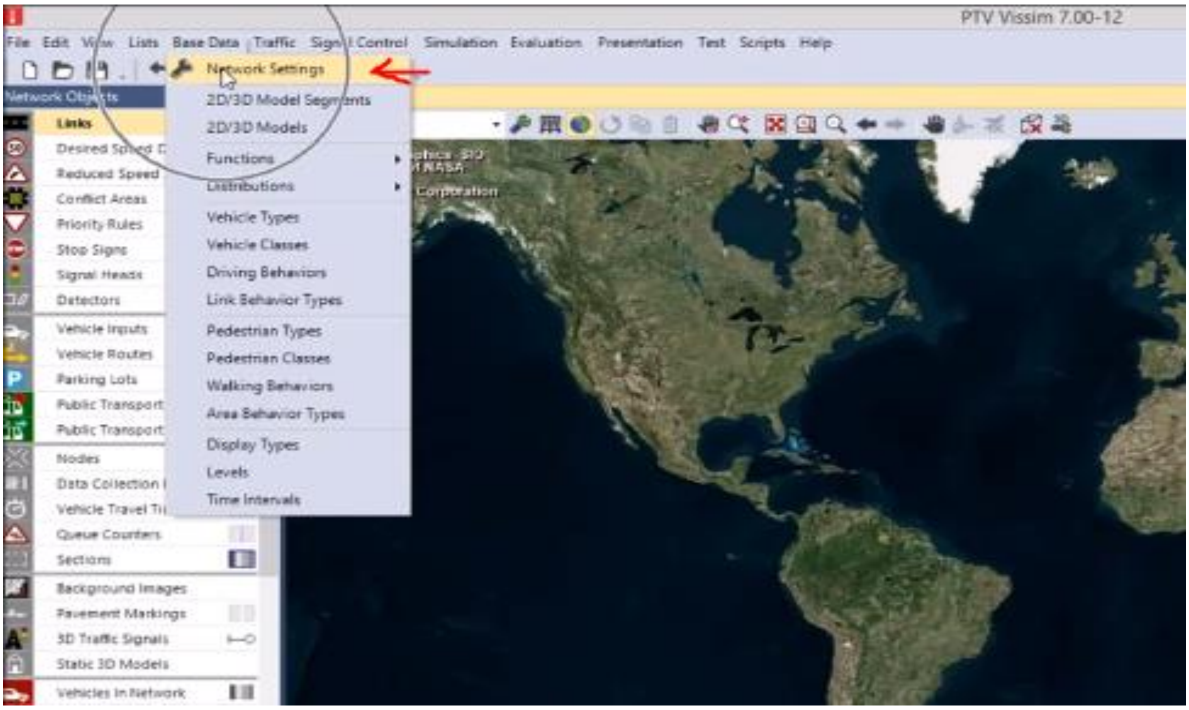


Fig. 17: PTV VISSIM network settings

Select the **Units** tab and adjust the working units as suited to you.

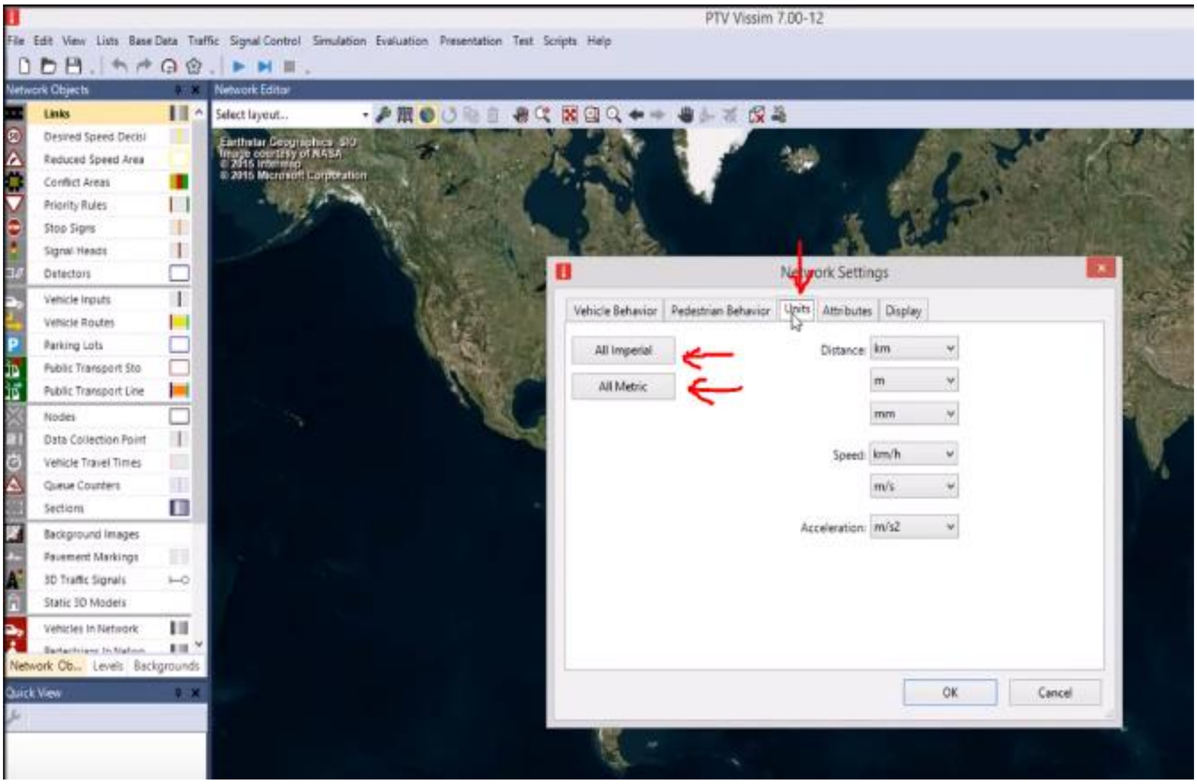


Fig. 18: PTV VISSIM units

4.2.2 Map Setting

Click the Multi-color ranch button from the toolbar directly above the map.

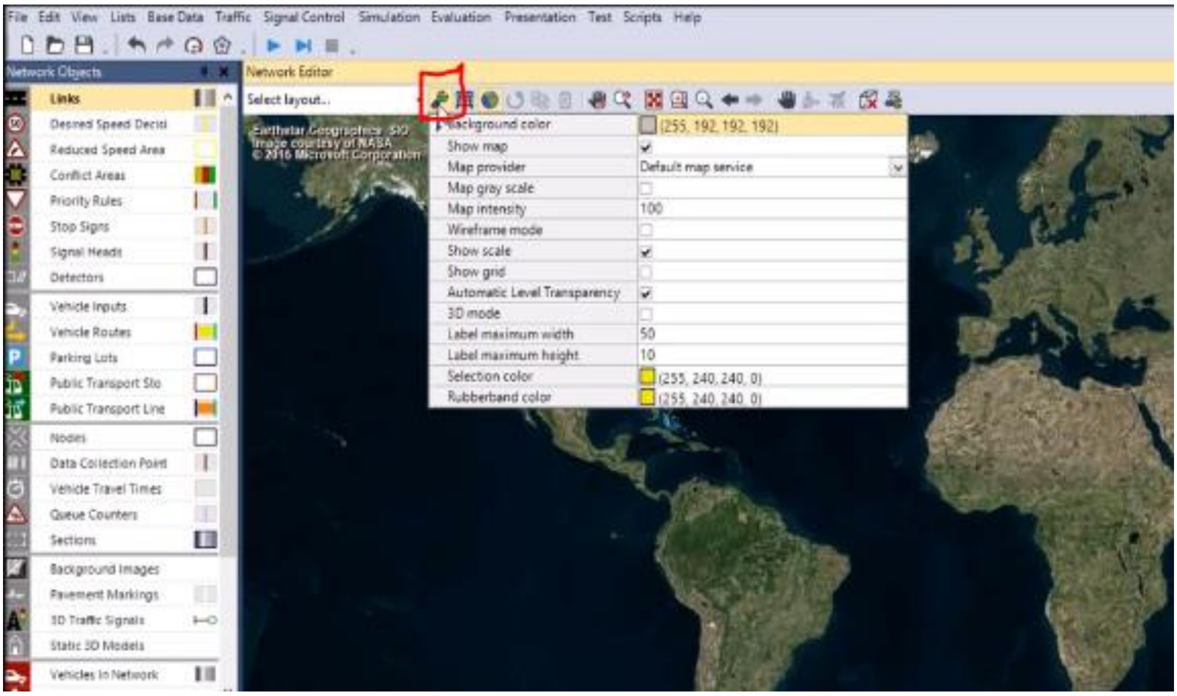


Fig. 19: PTV VISSIM map settings 1

From the **Map provider** option, you can click the **Drop-down** button and select the preferred map type e.g. **Bing maps** or **OpenStreetMap.**

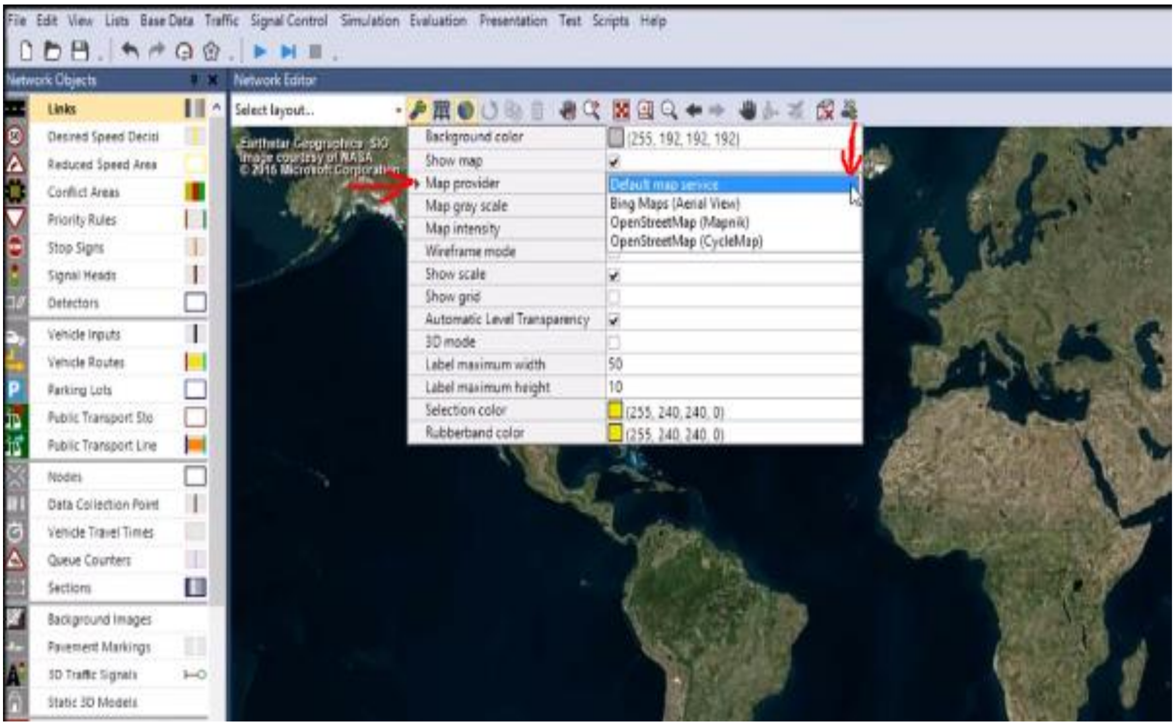


Fig. 20: PTV VISSIM map settings 2

4.2.3 Building a Network

When Creating the road networks, you have to first select the **Links** from Network Objects menu on the left side of screen.

Fig. 21: PTV VISSIM building a network 1

Then you can draw the network by **Control + Right Click** of desired length on the map.

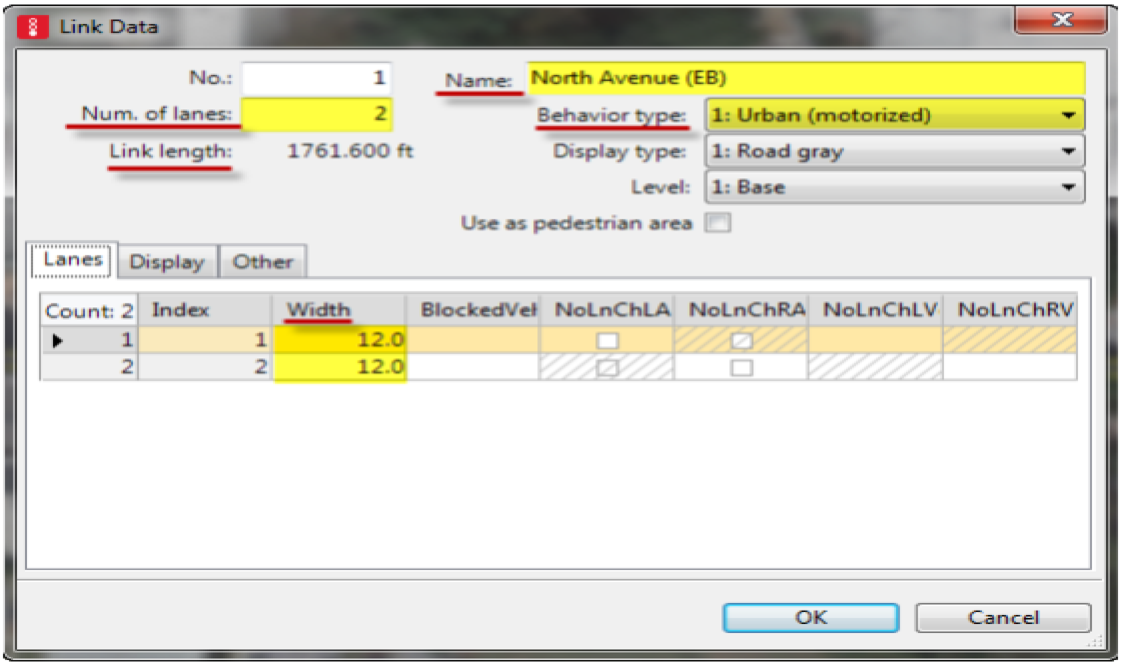


Fig. 22: PTV VISSIM building a network 2

A box will appear as shown in above picture. You assign the Network name, no. of lanes, behavior type etc. Also, the lane characteristics such as lane width. When you draw the network, it will be straight. If your road geometry is not straight you can **Right-click** on the drawn link and select Add Point option to add points on the network to align it accordingly to geometry.

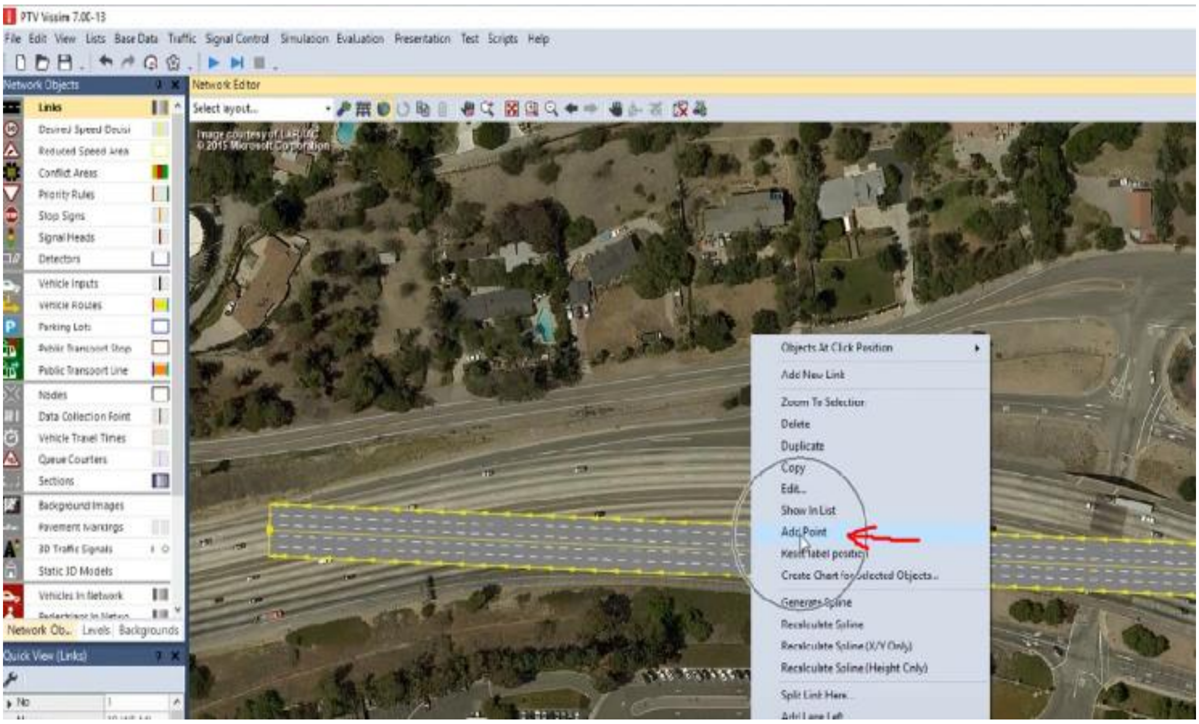


Fig. 23: PTV VISSIM building a network 3

You can move network from such points and align the network. Also, you can add multiple points.

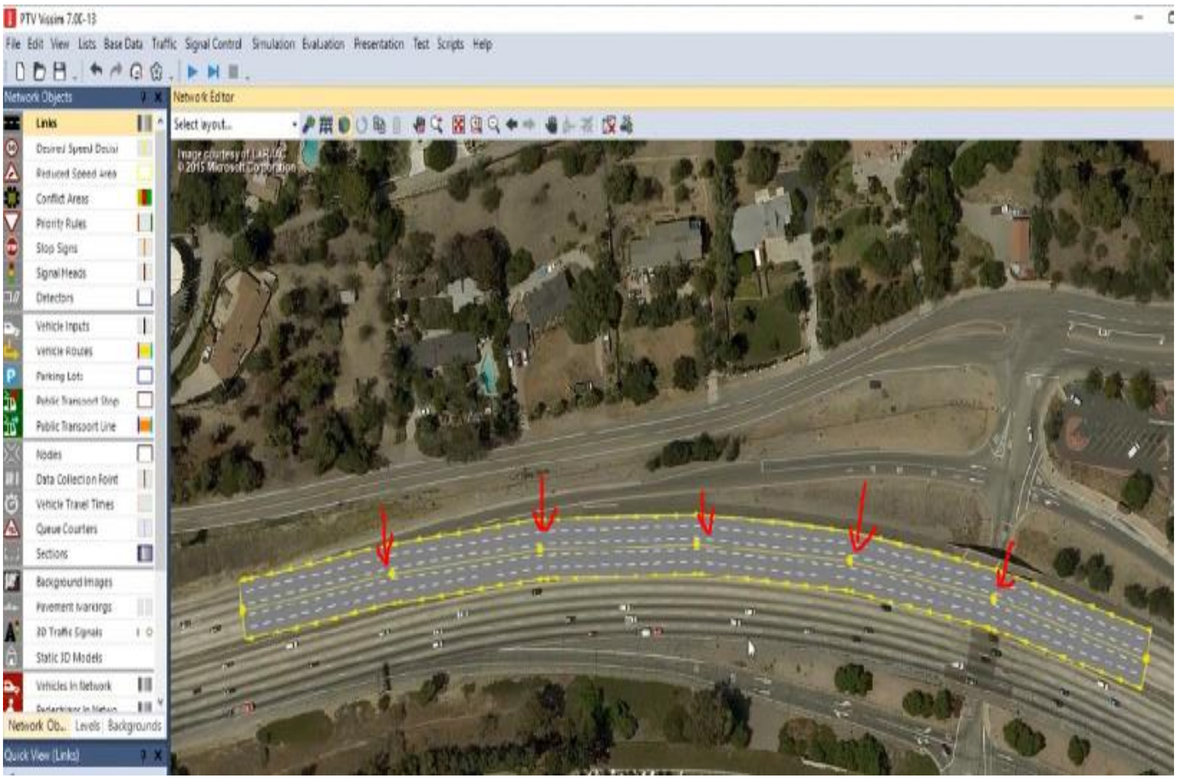


Fig. 24: PTV VISSIM building a network 4

To draw opposite lanes **Right-Click** the current network, and select the option **Generate Opposite Direction.** Enter **No. of lanes** for opposite direction and click **OK**.

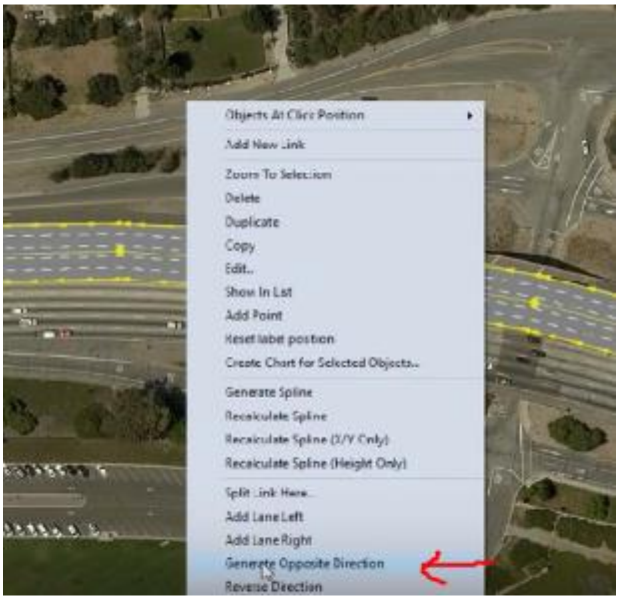


Fig. 25: PTV VISSIM building a network 5

Fig. 26: PTV VISSIM building a network 6

This will create the same network on opposite direction.

Fig. 27: PTV VISSIM building a network 7

Arrows along the network represent its direction of flow. You can always change that by **Right-Clicking** the network and select **Reverse Direction.**

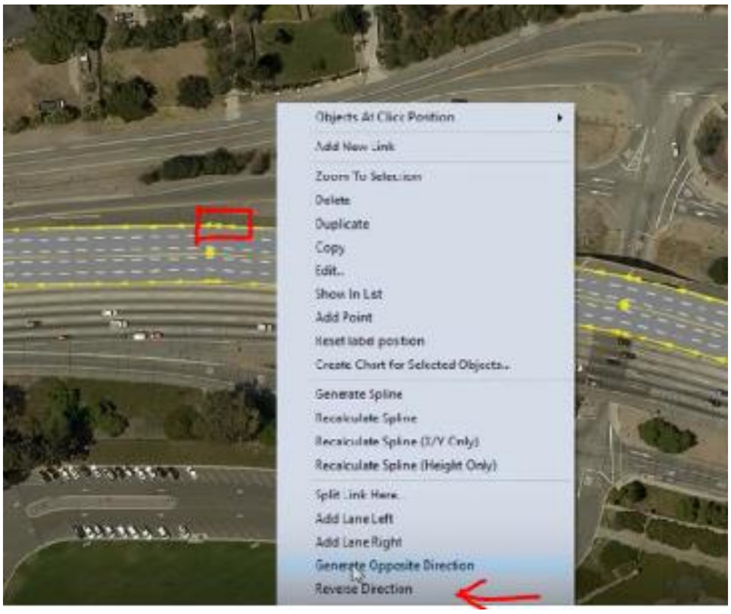


Fig. 28: PTV VISSIM building a network 8

4.2.4 Connectors

Connectors are basically to connect to networks drawn differently in Vissim. To draw a connector. Similarly, Select the **Links** for **Network Objects** menu. Draw a network starting from one existing network to another existing network this will draw a connector b/w them.

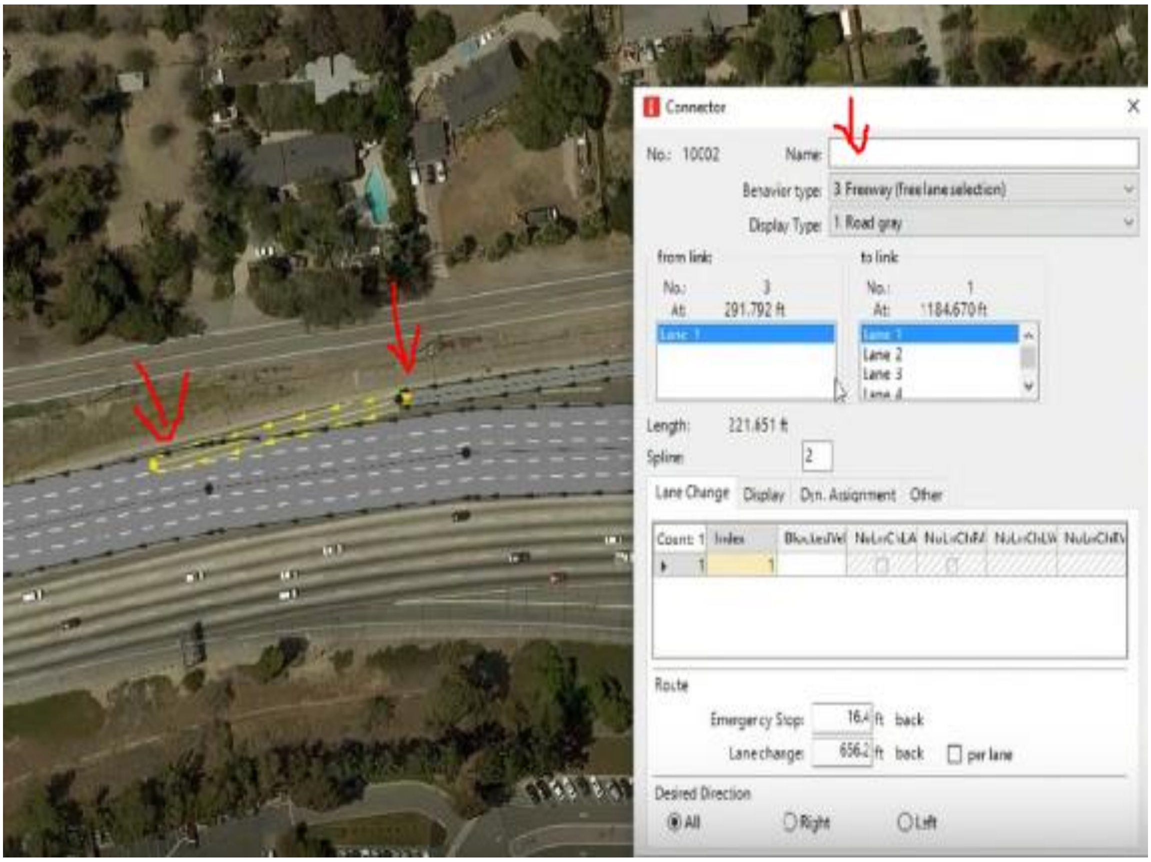


Fig. 29: PTV VISSIM connectors 1

Select the connector characteristics such as Name, Behavior type, connection to which lane, Emergency stop length etc. from connector box.

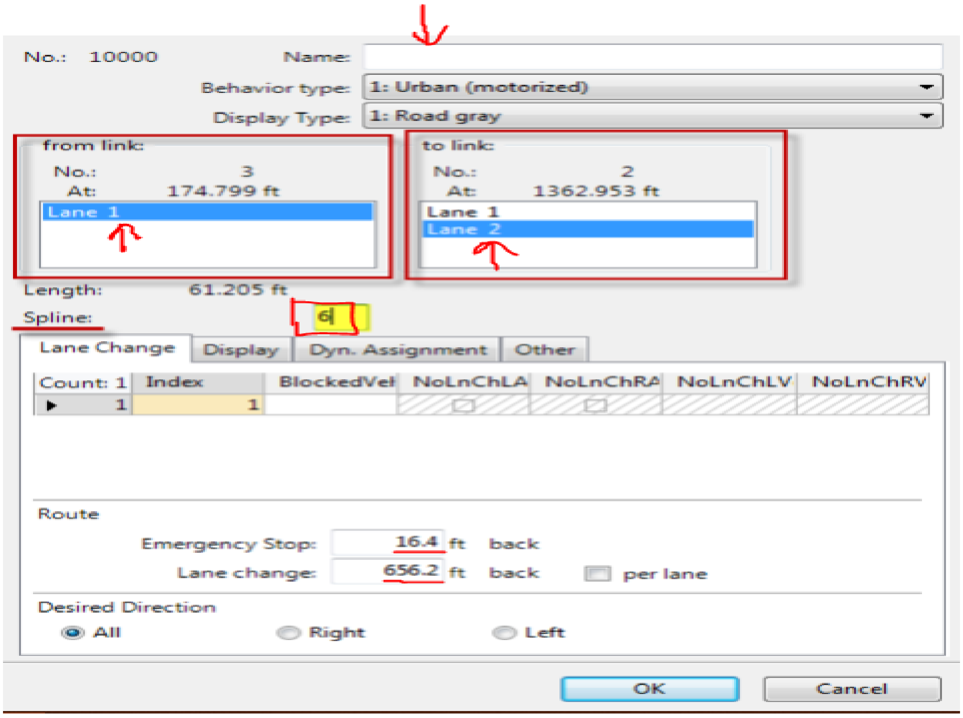


Fig. 30: PTV VISSIM connectors 2

Spline feature in this menu is to define how smooth the curve should be drawn. If you are connecting to straight networks then value '2' will be enough but if it's a curve then you should select large value. The greater the value the smoother the curve will be.

4.2.5 Vehicle Data

To enter the vehicle data on network, First go to the start of network from where the vehicles will start entering the network. From **Network Objects** menu, Select the option **Vehicle Inputs**.

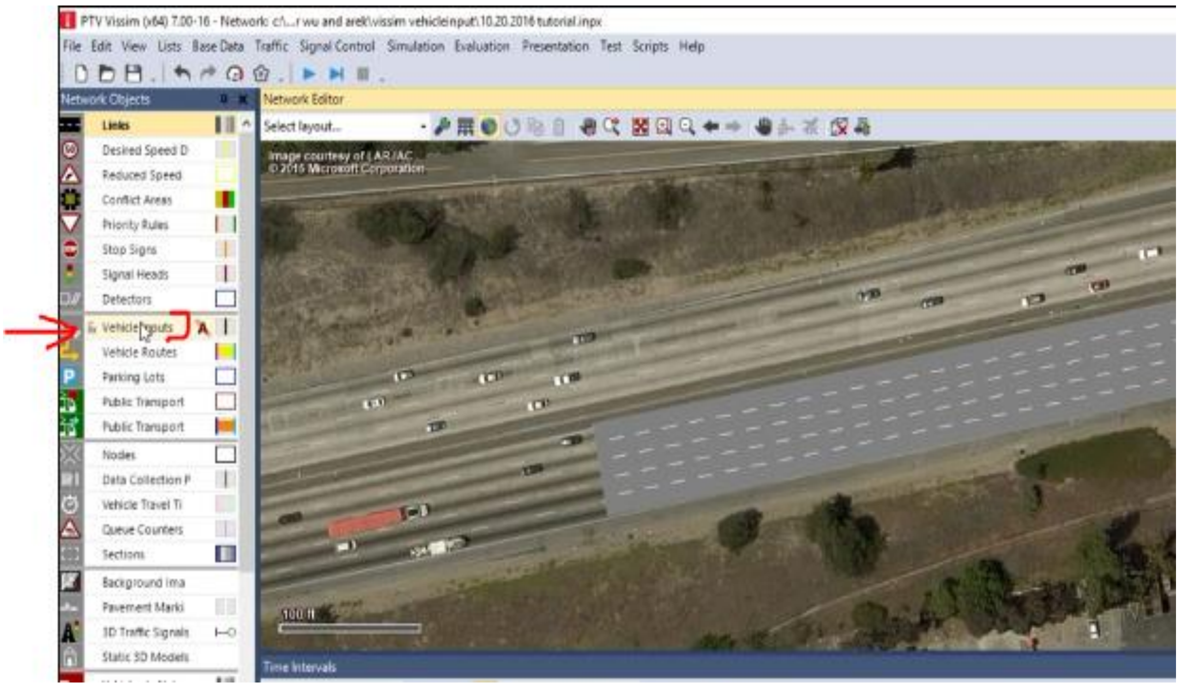


Fig. 31: PTV VISSIM vehicle data 1

Right-Click on the network and Select **Add New Vehicle Input..** A Black line will appear on the start of network indicates it done

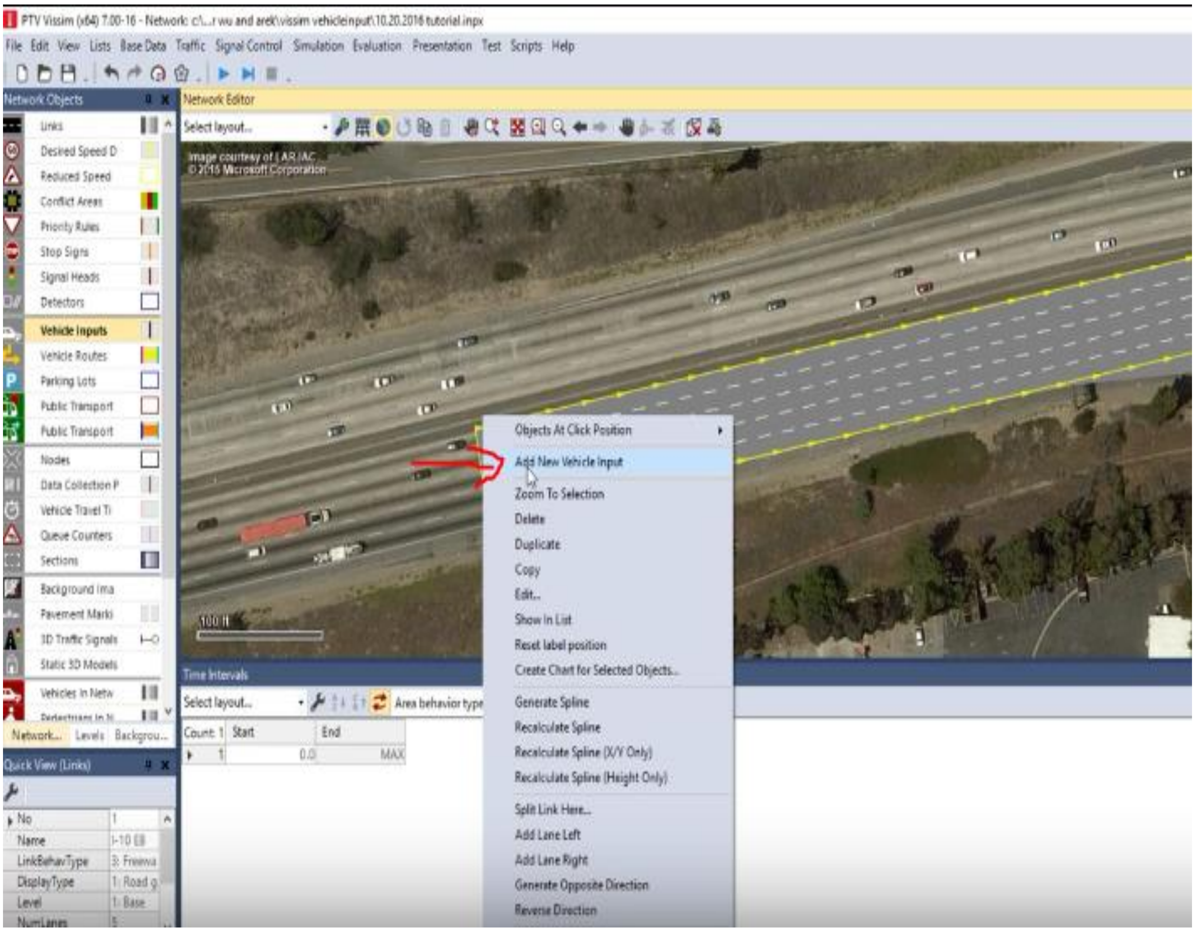


Fig. 32: PTV VISSIM vehicle data 2

Vehicle input window will appear at bottom. You can add volume for the desired network.

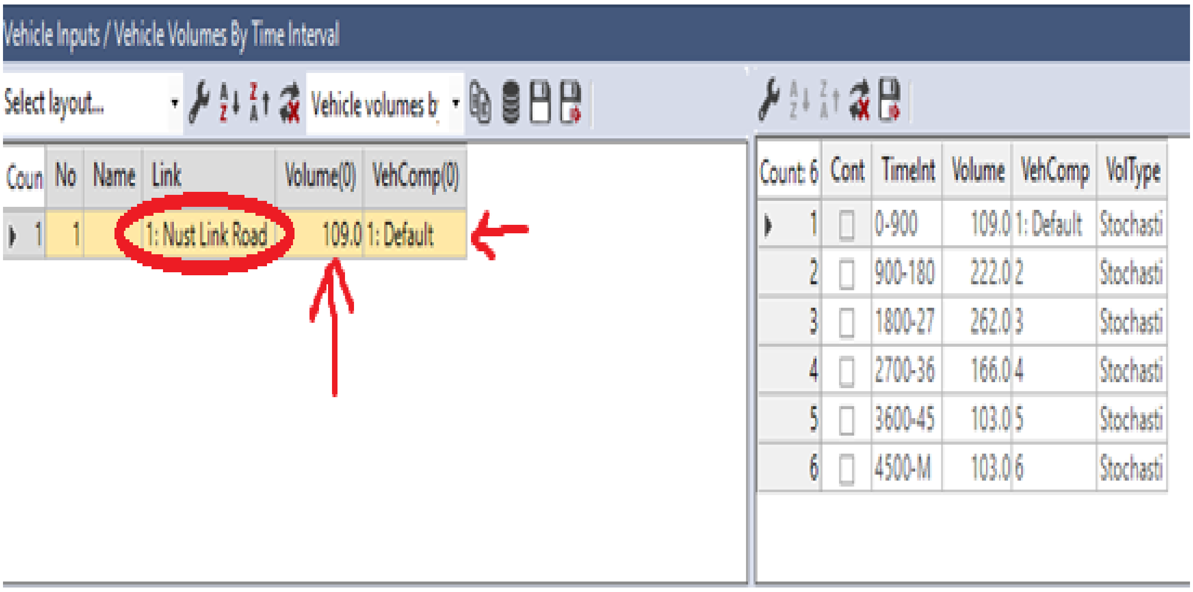


Fig. 33: PTV VISSIM vehicle data 3

For time intervals, Select ‘**Vehicle volumes by time interval**’ from menu. And it will split window into two. Right Click in the right window and Select **Add Intervals**.

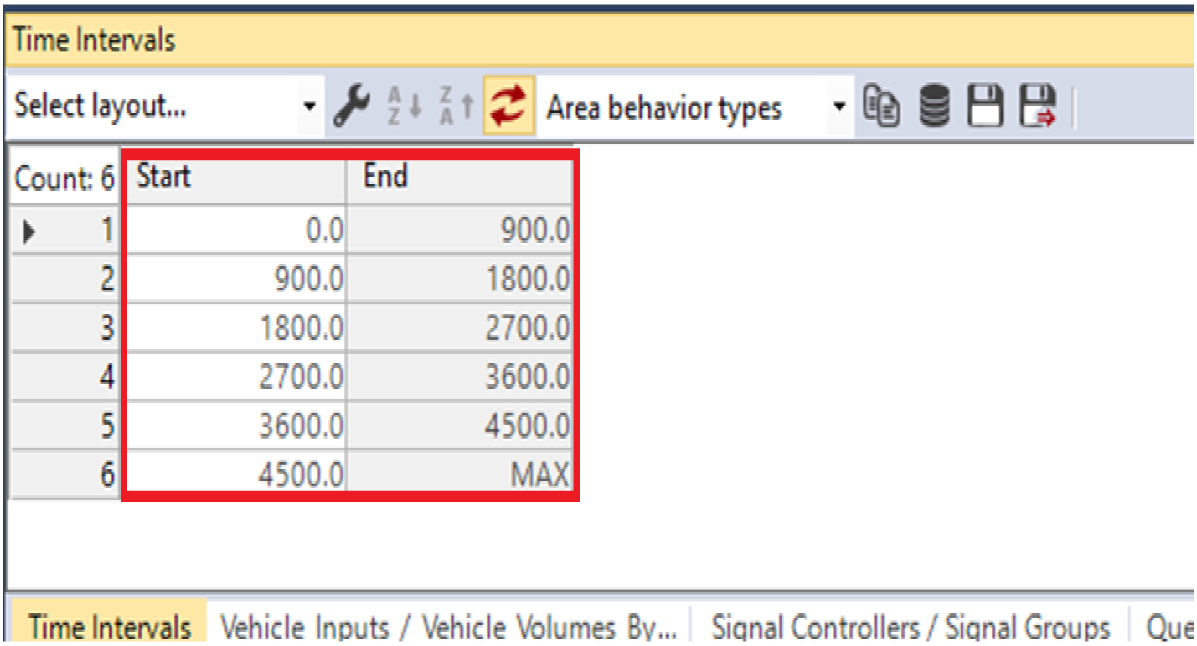


Fig. 34: PTV VISSIM vehicle data 4

Then input values of Volume for different intervals.

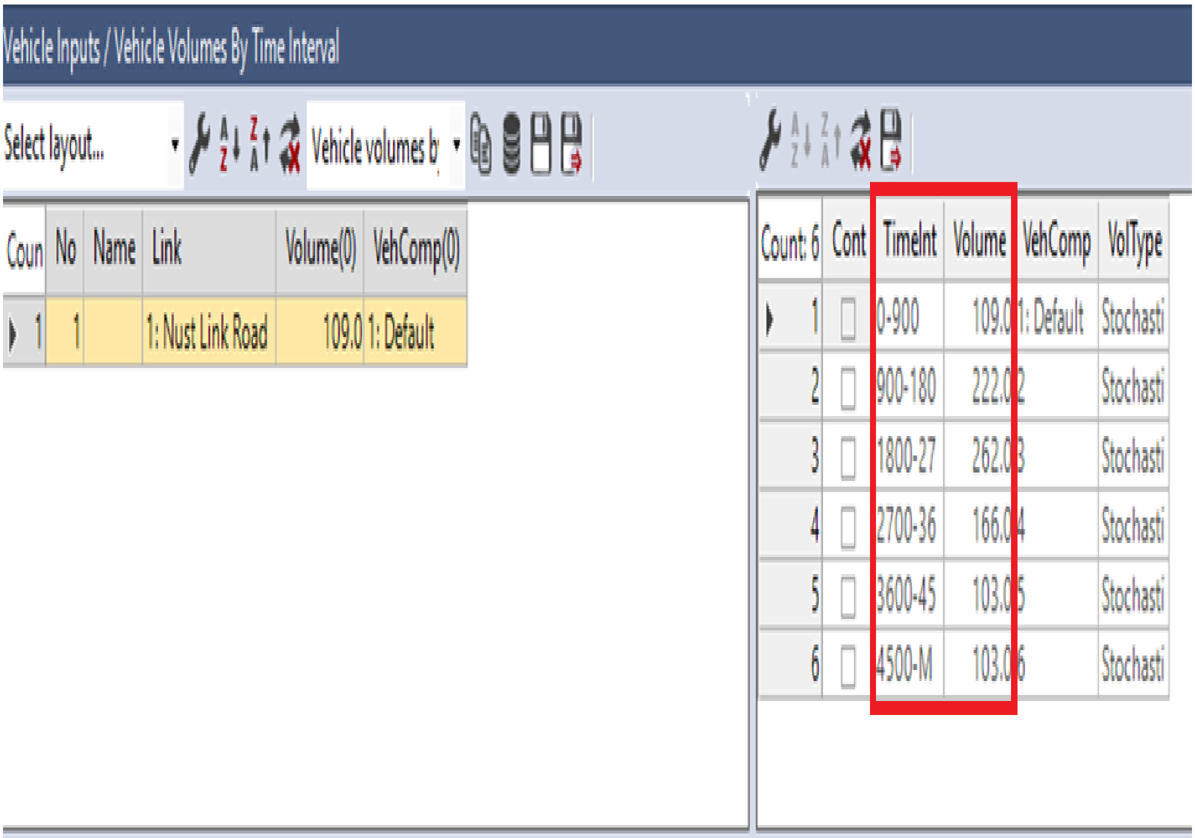


Fig. 35: PTV VISSIM vehicle data 5

For changing the vehicle composition Go to **Traffic** >> **Vehicle Compositions.** You can make multiple Vehicle Compositions for different intervals also.

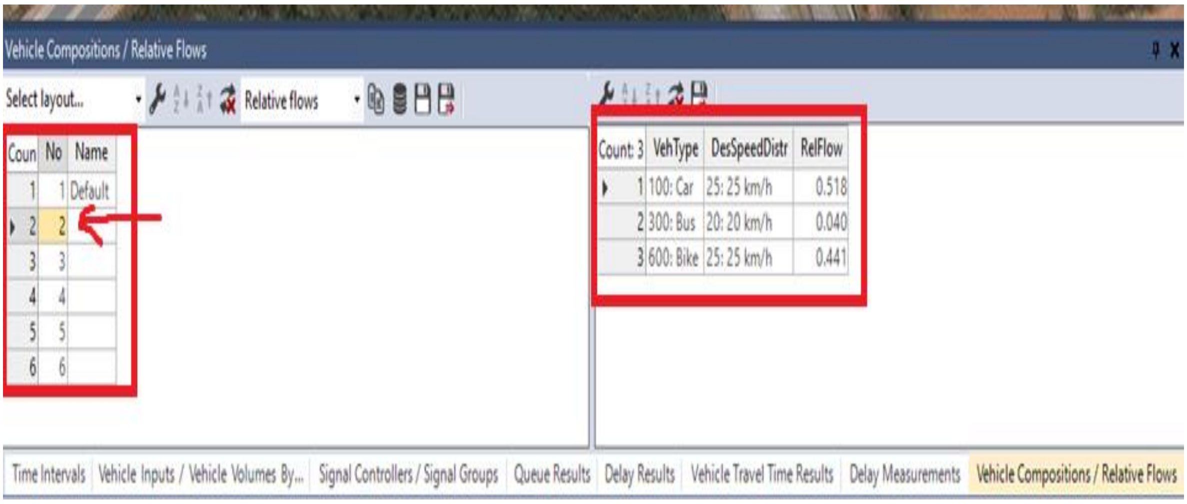


Fig. 36: PTV VISSIM vehicle data 6

Now you can choose different compositions for different intervals in **Vehicle Input** window

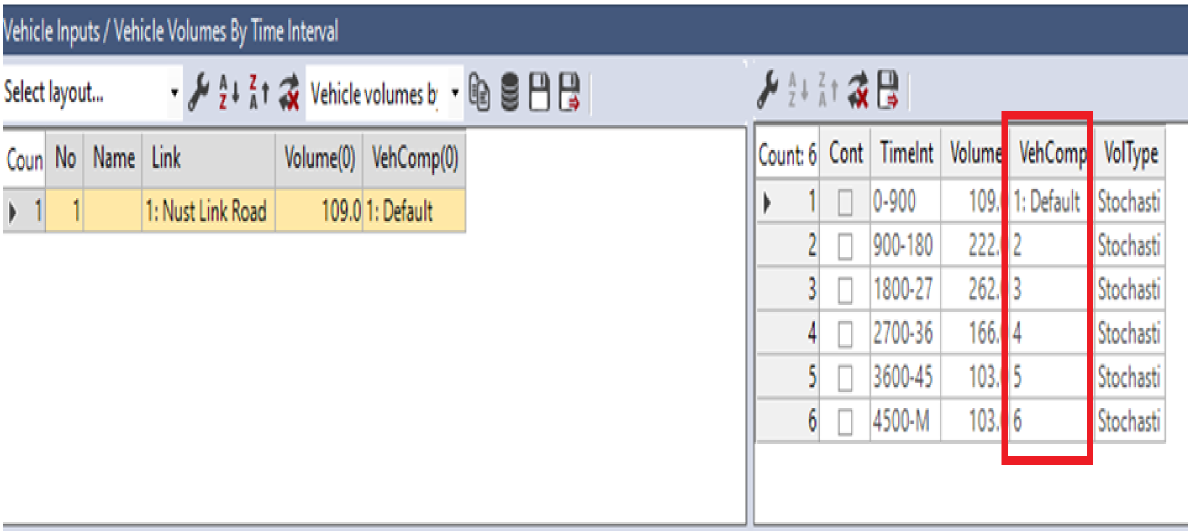


Fig. 37: PTV VISSIM vehicle data 7

4.2.6 Signal Control

Right-Click in the window and Select **ADD**.

Fig. 38: PTV VISSIM signal control 1

Assign a Name to Signal Controller and from drop-down men Select **Fixed time** and then Select **Edit Signal Control**.

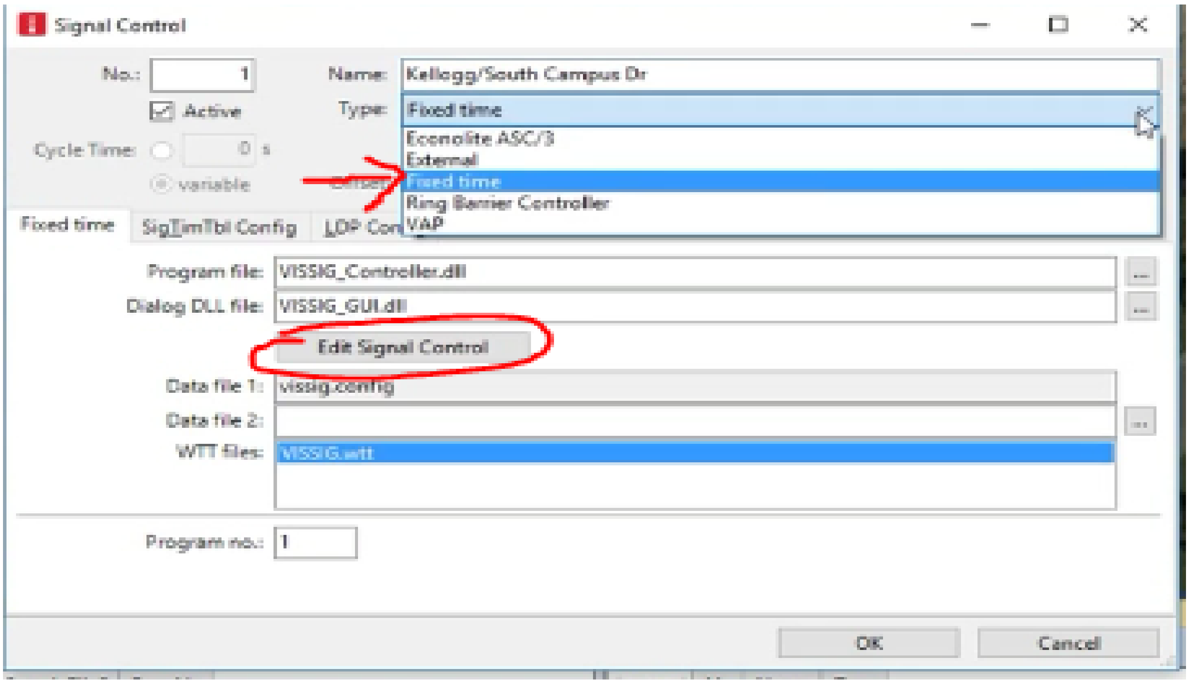


Fig. 39: PTV VISSIM signal control 2

Add the Required number of Signal Groups into **Signal Groups** tab by Clicking **New** button

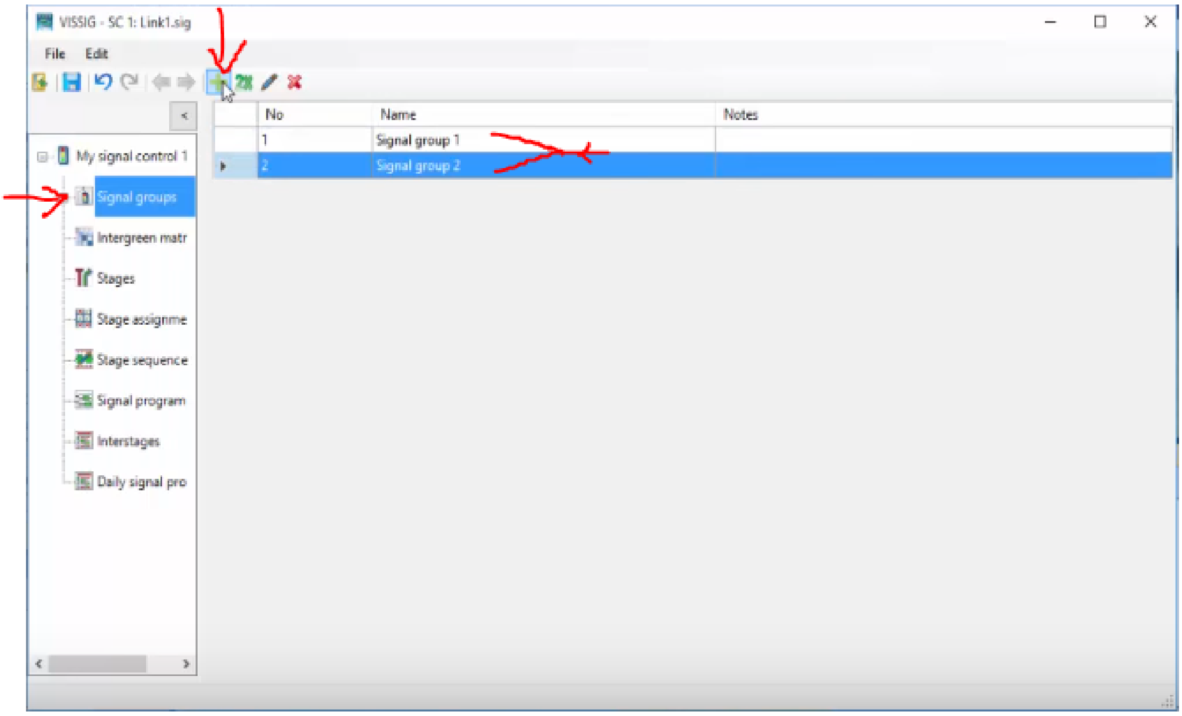


Fig. 40: PTV VISSIM signal control 3

Click the '+' Button along Signal Group tab and Select a Signal and Group and set its characteristics such as Sequence and durations of sequence.

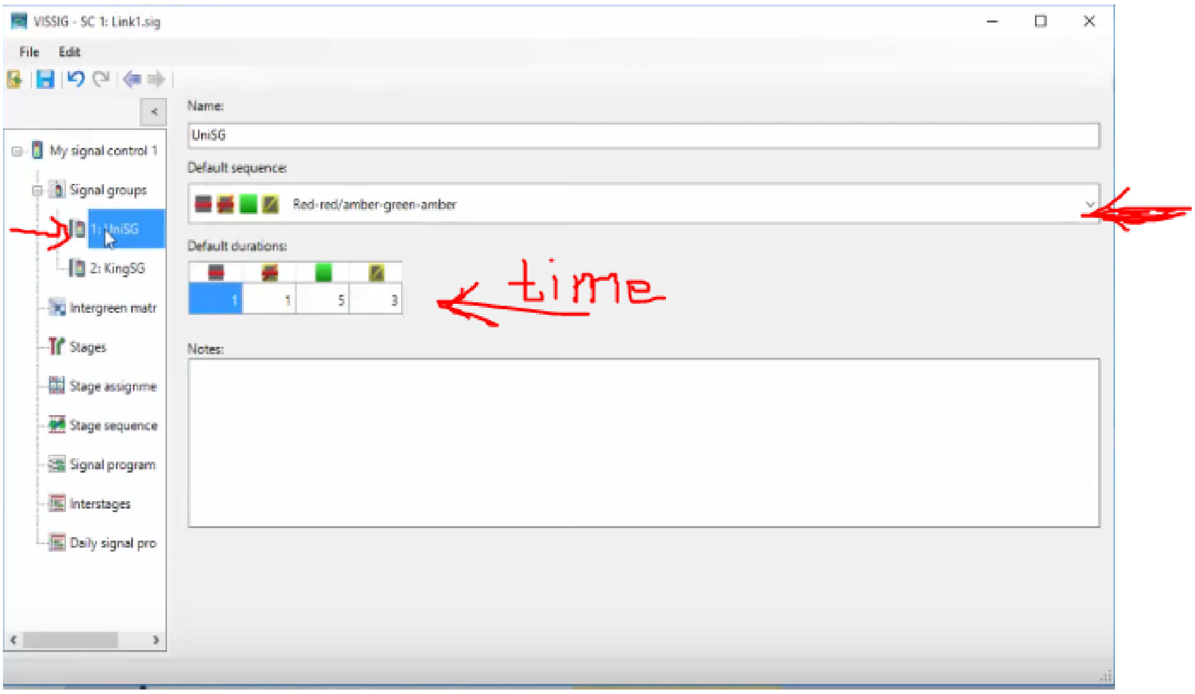


Fig. 41: PTV VISSIM signal control 4

Now Go to **Signal Program** tab and add desired number of signal programs.

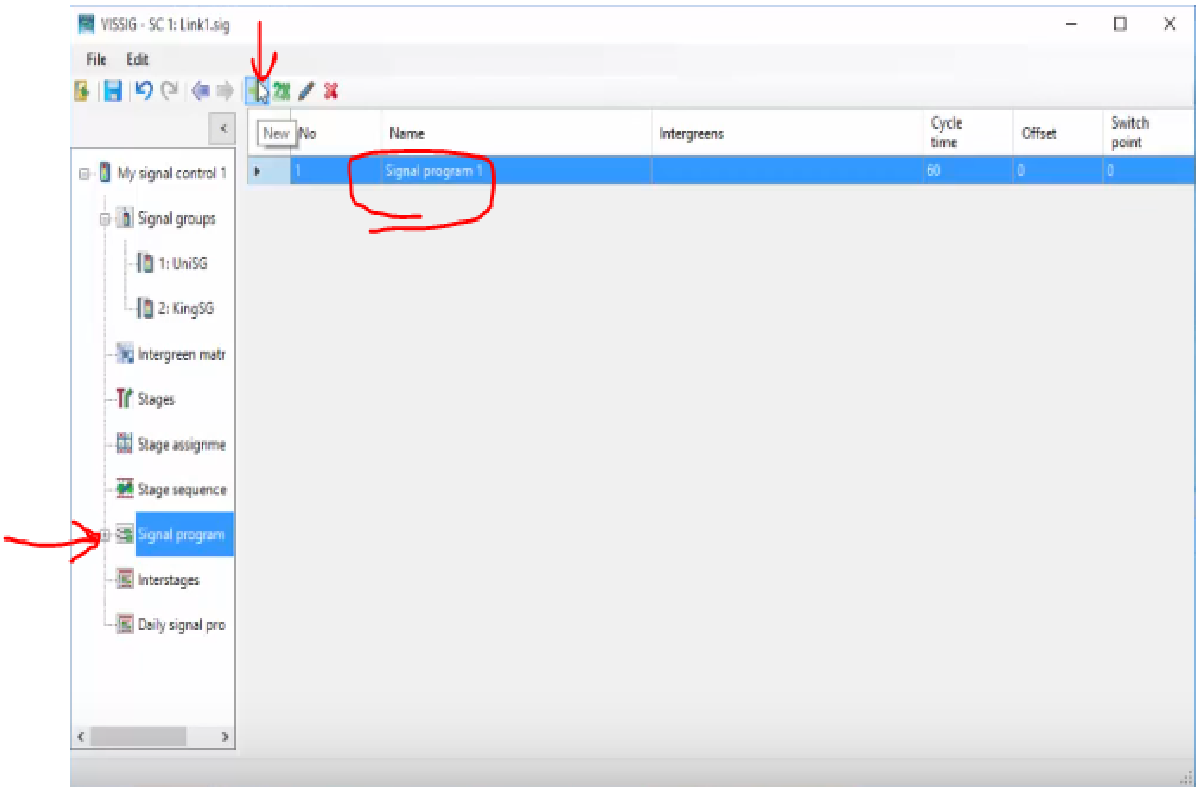


Fig. 42: PTV VISSIM signal control 5

From sub-menu Select the desired controller and adjust your control at any cycle time.

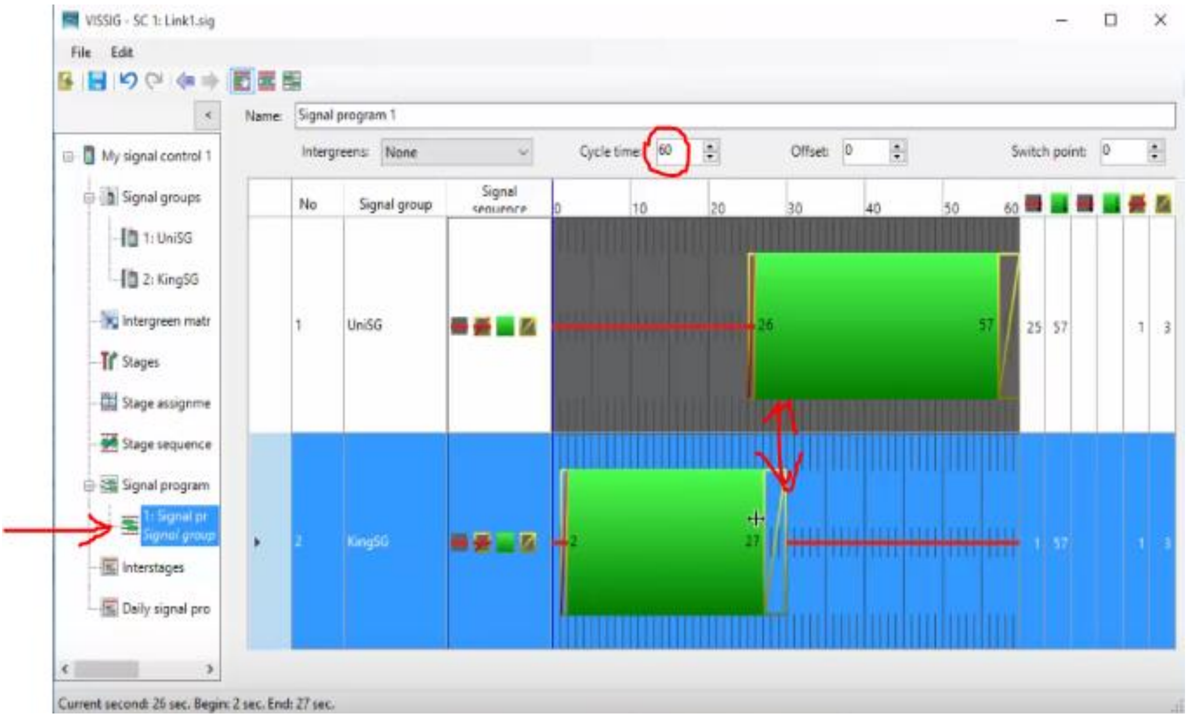


Fig. 43: PTV VISSIM signal control 6

Now go to intersection. Select the **Signal Head** from **Network Objectives**. Right click on network where want to place signal head and Select signal head properties in new window e.g. SG (Signal Group) and SC (Signal Controller).

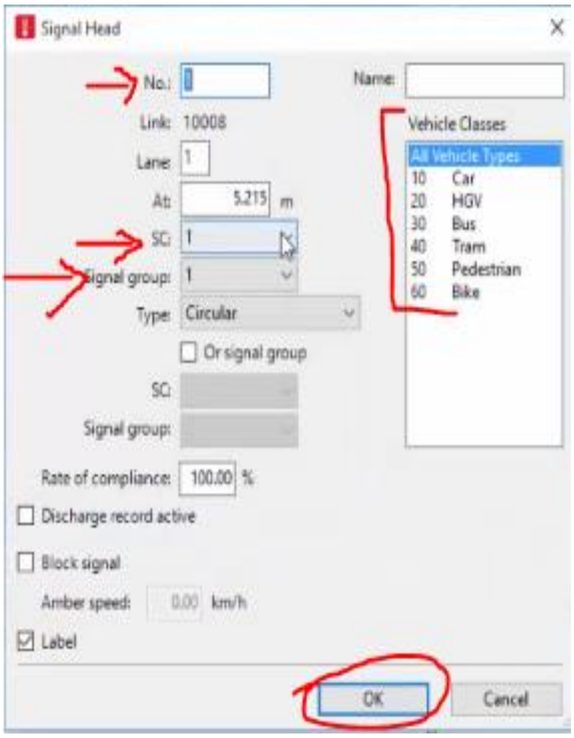


Fig. 44: PTV VISSIM signal control 7

4.2.7 Running Simulation

Adjust the Simulation Parameters by Going to **Simulation** >> **Parameters.** Set the parameters.

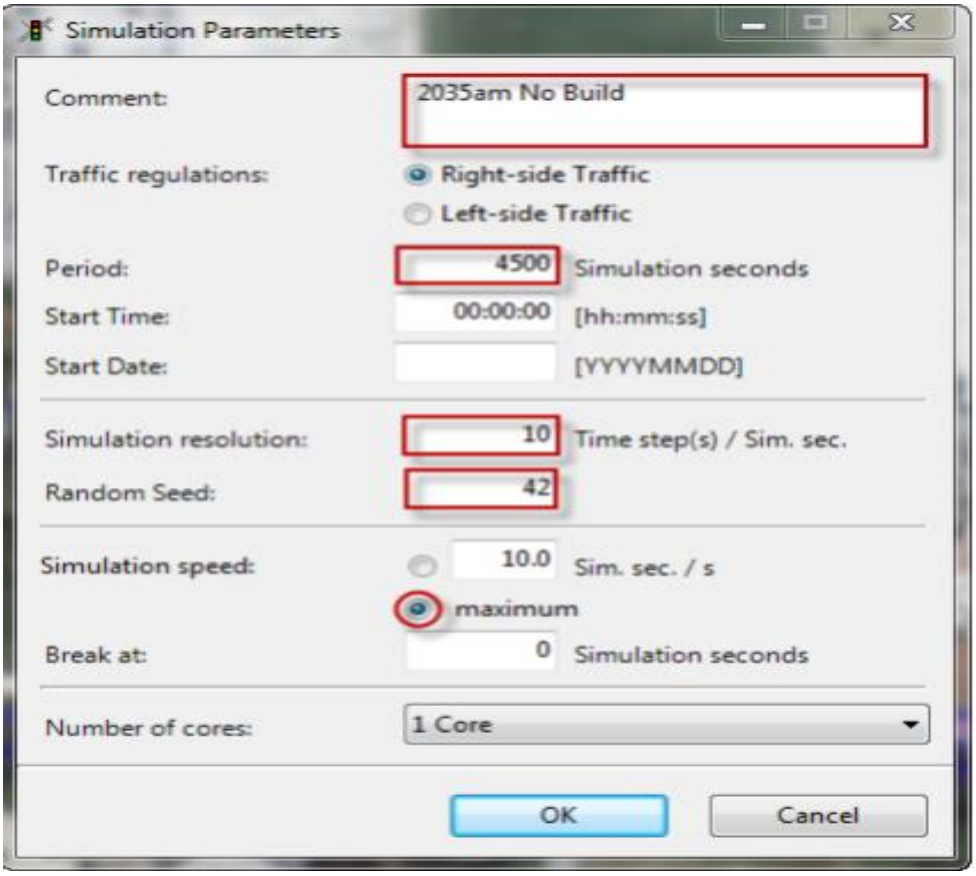


Fig. 45: PTV VISSIM running simulation 1

Control the simulation from Simulation controls on the top.

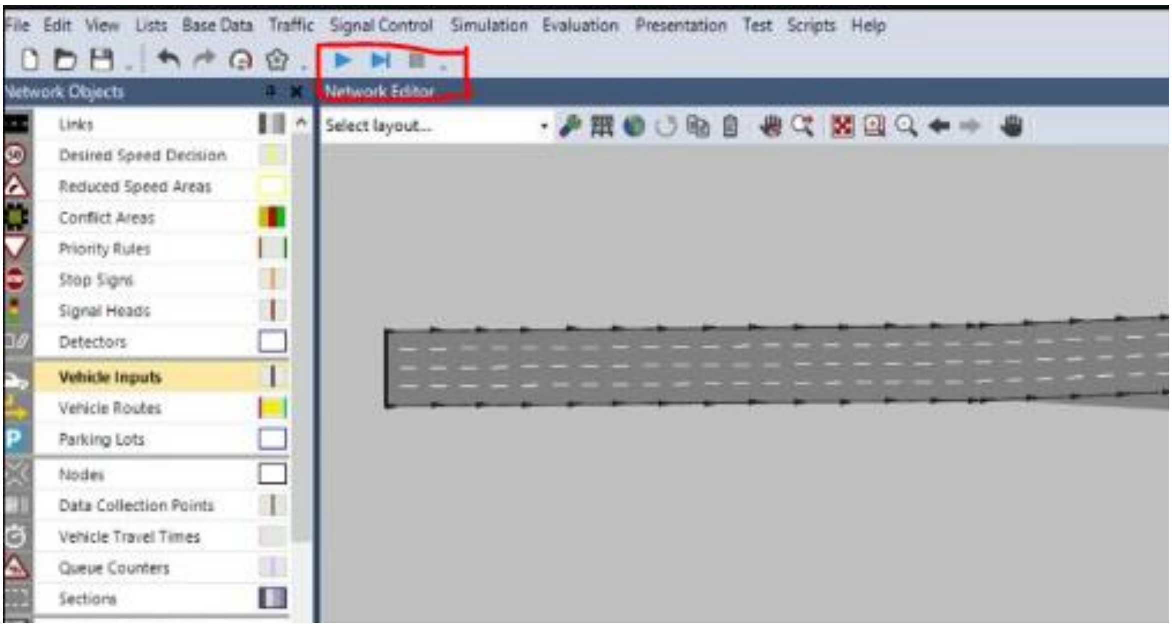


Fig. 46: PTV VISSIM running simulation 2

4.2.8 Collecting Results

Add different collection points on the network where you want the data. Collection point options include **Data Collection**, **Vehicle Travel Time** and **Queue counter** etc. After Placing the collection point from **Network Object** menu, Go to **Evaluation** >> **Configure**

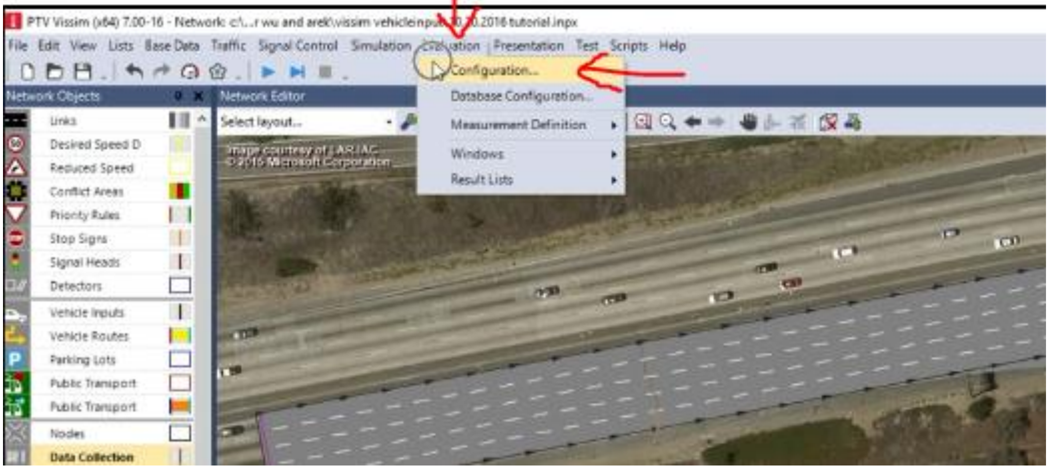


Fig. 47: PTV VISSIM collecting Results 1

Check the Perimeters that you want to analyze during simulation in the new window. If want values for intervals you can also set value of interval length.

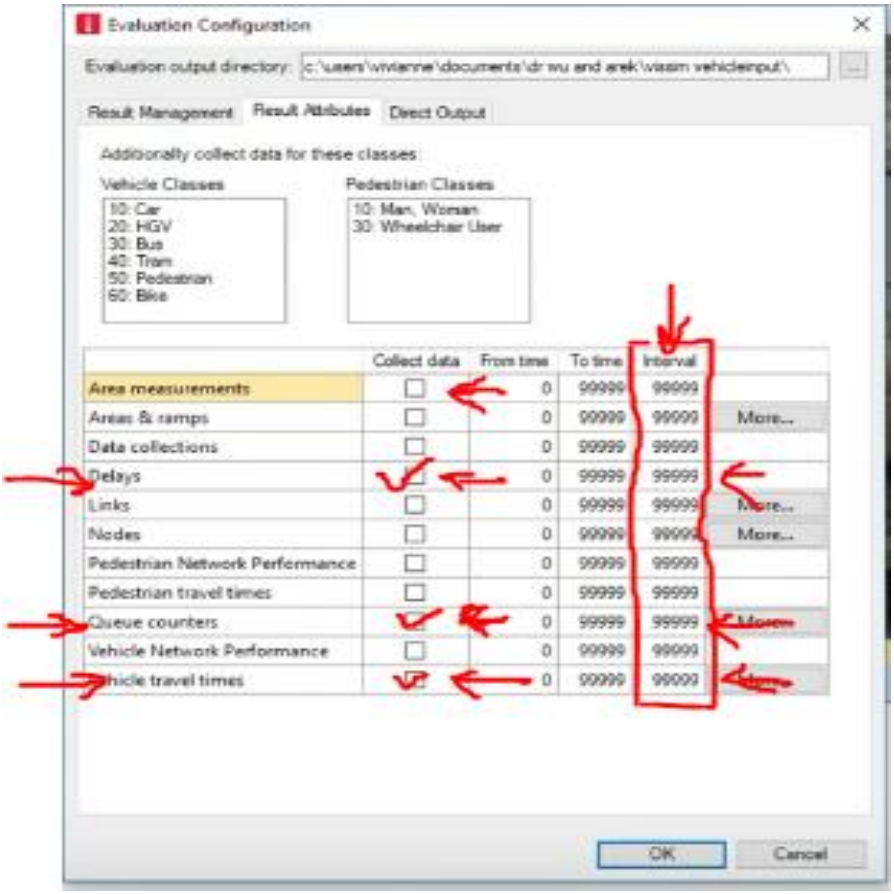


Fig. 48: PTV VISSIM collecting Results 2

Run the Simulation, after simulation completed go to saving directory and text files will be saved there.

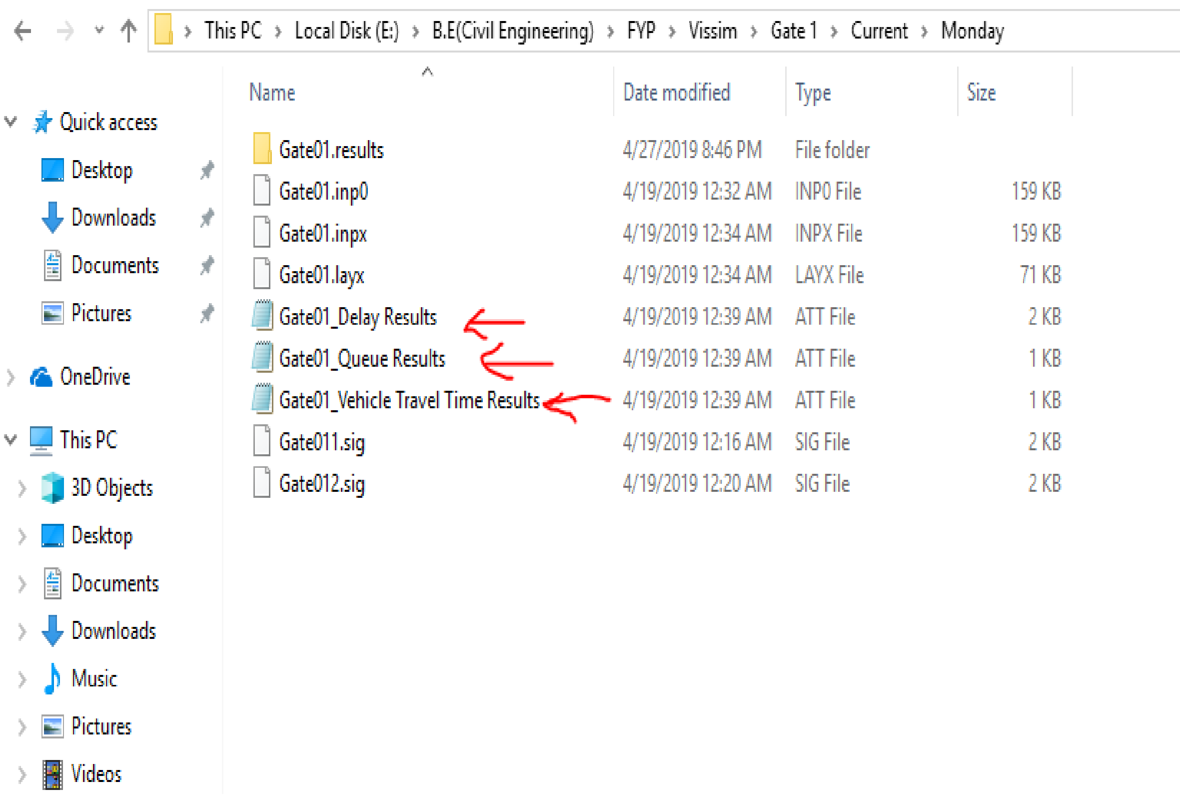
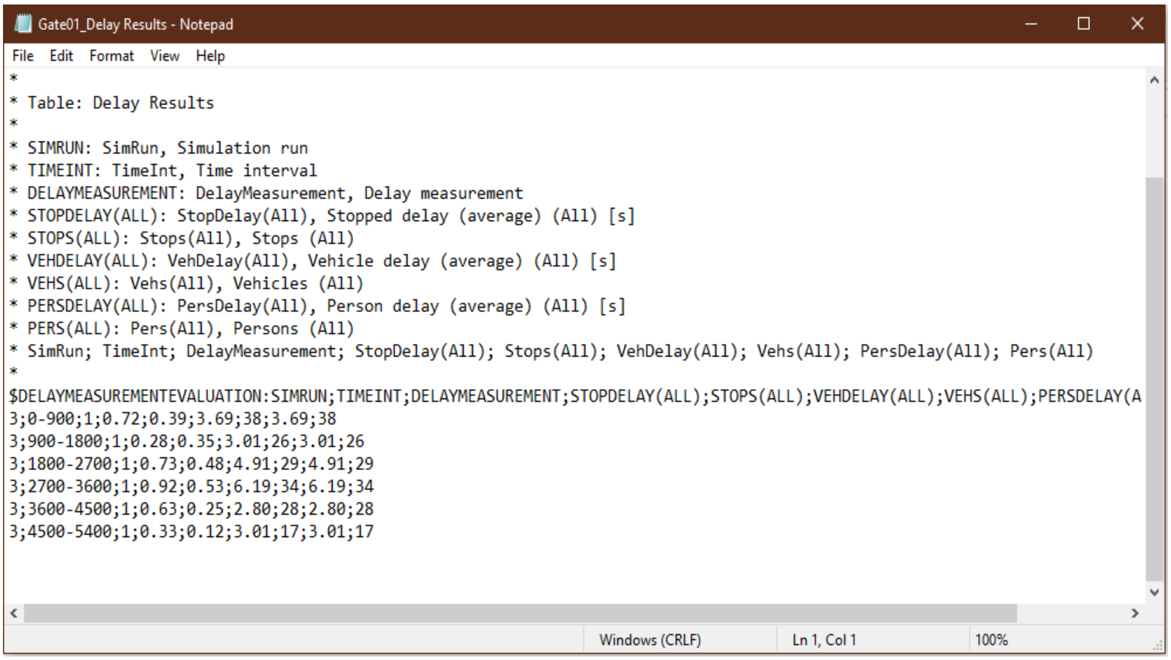


Fig. 49: PTV VISSIM collecting Results 3



Gate01_Delay Results - Notepad

File Edit Format View Help

```
*
* Table: Delay Results
*
* SIMRUN: SimRun, Simulation run
* TIMEINT: TimeInt, Time interval
* DELAYMEASUREMENT: DelayMeasurement, Delay measurement
* STOPDELAY(ALL): StopDelay(All), Stopped delay (average) (All) [s]
* STOPS(ALL): Stops(All), Stops (All)
* VEHDELAY(ALL): VehDelay(All), Vehicle delay (average) (All) [s]
* VEHS(ALL): Vehs(All), Vehicles (All)
* PERSDELAY(ALL): PersDelay(All), Person delay (average) (All) [s]
* PERS(ALL): Pers(All), Persons (All)
* SimRun; TimeInt; DelayMeasurement; StopDelay(All); Stops(All); VehDelay(All); Vehs(All); PersDelay(All); Pers(All)
*
$DELAYMEASUREMENTEVALUATION:SIMRUN;TIMEINT;DELAYMEASUREMENT;STOPDELAY(ALL);STOPS(ALL);VEHDELAY(ALL);VEHS(ALL);PERSDELAY(A
3;0-900;1;0.72;0.39;3.69;38;3.69;38
3;900-1800;1;0.28;0.35;3.01;26;3.01;26
3;1800-2700;1;0.73;0.48;4.91;29;4.91;29
3;2700-3600;1;0.92;0.53;6.19;34;6.19;34
3;3600-4500;1;0.63;0.25;2.80;28;2.80;28
3;4500-5400;1;0.33;0.12;3.01;17;3.01;17
```

Windows (CRLF) Ln 1, Col 1 100%

Fig. 50: PTV VISSIM collecting Results 4

PROPOSED DESIGN ALTERNATIVES

5.1 Introduction

The current design for gates was causing problem in order to avoid conflict and smoothen the traffic flow new gate designs were proposed keeping in mind the existing structure and constraints it was tried that the existing design can be modified to meet our needs and by doing so cost could be minimized

5.2 Proposed Design for Gate-1

- Motorcycle lane is added to Gate-1 design
- Median of 2' between lanes for channelizing
- Intersection was replaced by U-turn in order to avoid conflicts

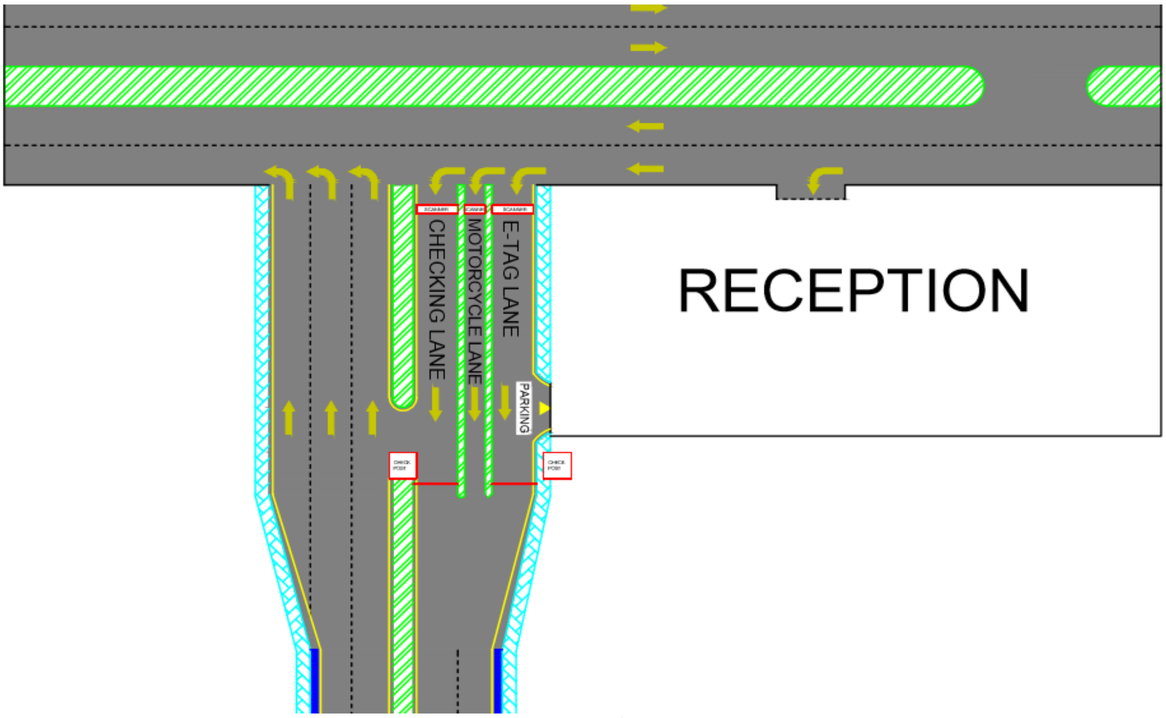


Fig. 51: Proposed design for Gate-1

5.2.1 Design Parameters

Table 2: New Design Specifications Gate-1

New Design Specifications	
	Gate-1
Lane Width	10'-0"/06'-0"
Median Openings	25'-0"
Footpath	8'-0"
Drainage	-
Median	9'-0"

5.3 Proposed Design for Gate-2

- Additional lane at Gate-2 to accommodate more vehicles
- Check post was moved forward to provide room for queue formation
- Island was introduced to smoothen the traffic flow
- E-tag was used for local university cars
- U-turn was provided

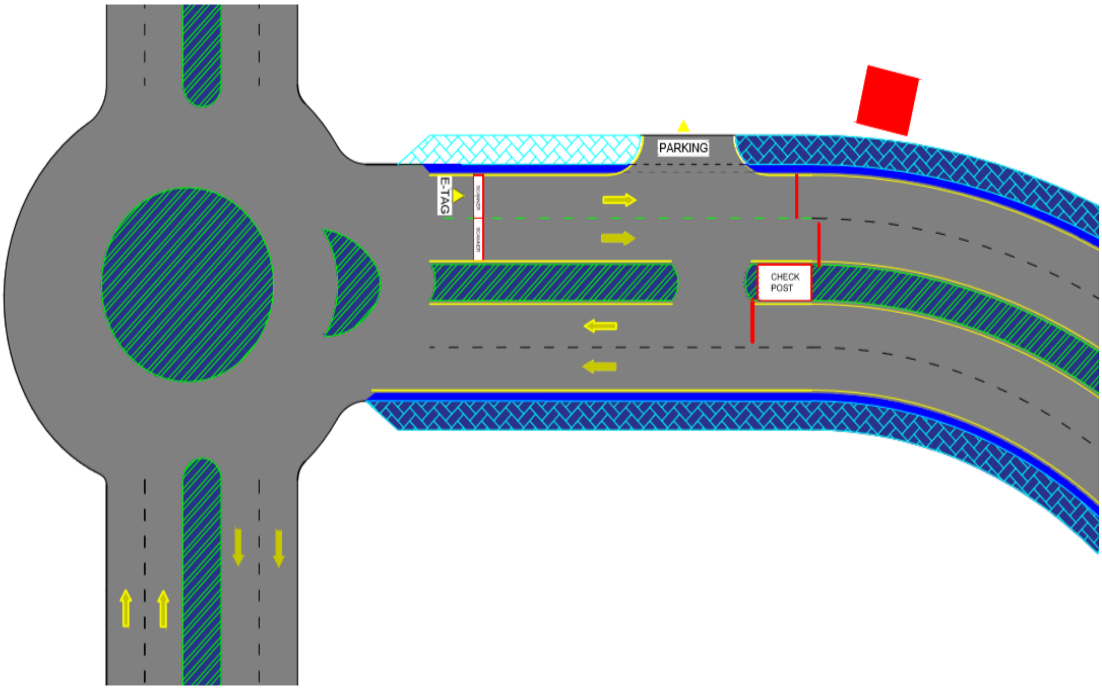


Fig. 52: Proposed design for Gate-2

5.3.1 Design Parameters

Table 3: New Design Specifications Gate-2

New Design Specifications	
	Gate-2
Lane Width	10'-0"
Median Openings	-
Footpath	7'-6"
Drainage	2'-0"
Median	10'-0"

5.4 Proposed Design for Gate-10

- Gate-10 is operable for E-Tag vehicles only
- Check post was moved to avoid conflicts
- Proper channelization for smooth traffic flow

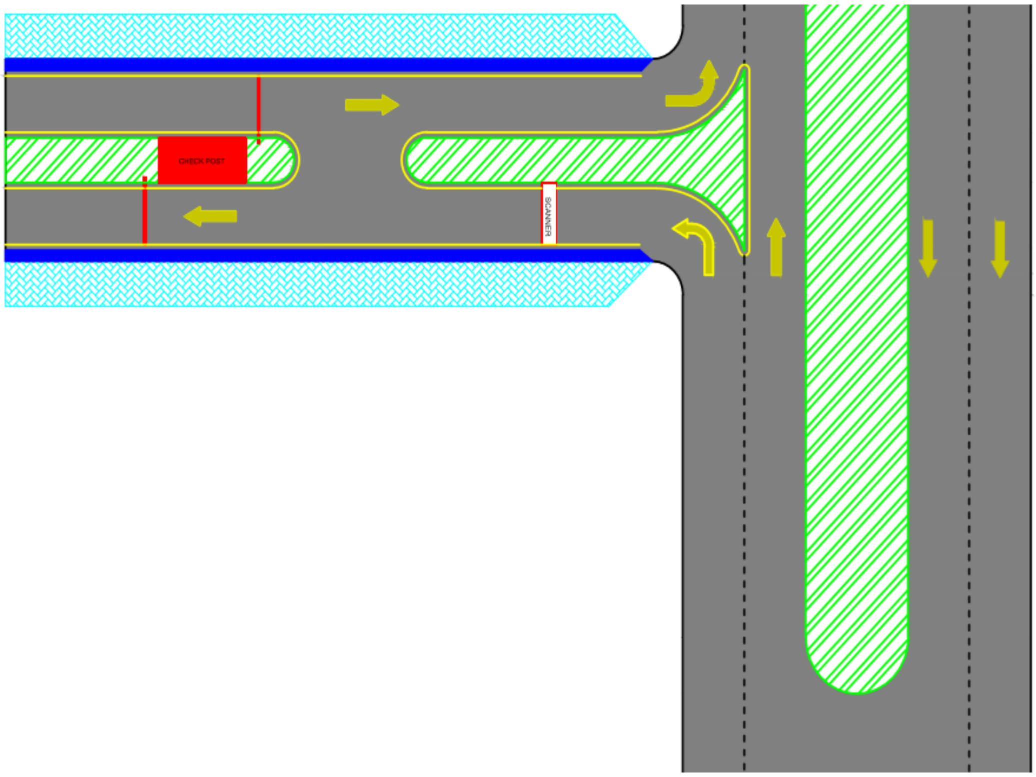


Fig. 53: Proposed design for Gate-10

5.4.1 Design Parameters

Table 4: New Design Specifications Gate-10

New Design Specifications	
	Gate-10
Lane Width	10'-0"
Median Openings	20'-0"
Footpath	8'-0"
Drainage	2'-0"
Median	20'-0"/10'-0"

5.6 Advantages

- Shorter queue lengths
- Lesser delay times
- Smooth flow
- Travel convenience
- Reduced conflicting zones

5.7 Disadvantages

- Security concerns
- Initial inconvenience
- Difficult for the reader to scan in case of metal or glass surfaces

Chapter 6

RESULTS AND ANALYSIS

6.1 Introduction

In this section, we will be showing a process of analysis on the data to inspect, model and transform the data by which decision-making criteria would be done in the form of results. Main part of our project is to analyze the gathered data by the team and provide a suitable, effective and efficient outcome.

Specific to our Project, we are considering total three gates of the NUST:

- Gate#1
- Gate#2
- Gate#10

Software analysis as well as manual analysis is done on the data collected to show their results. Then same analysis is to be done on the proposed design which we have introduced to control the traffic in reduction of time delay for a vehicle to pass through the gate and queue generation by vehicles.

6.2 Traffic Volume Counts

Traffic volume data is the number of traffic attendants passing through a certain section of the road over a certain period - is the crucial information indicating the importance of road.

In our project, Traffic Volume is considered to be the data.

For Data collection, there could be more methods of collecting traffic data but we consider some ways of collecting data as follows:

- **By manually counting the traffic volume.**
- By surveying department to department inside the university to gather the information from students, staff and faculty using these gates regularly.
- By making a video then collect data from it.
- By using invasive techniques such as Magnetic Sensors, radars or piezo-sensors.

For convenience, inexpensive and efficient method of collecting data, first method has been chosen.

Traffic Volume consists of different type of vehicles. We have classified traffic volume in three classes and collected separately with their separate sections:

- Cars
- Motorbikes
- Buses/Wagons

The data has been collected at morning and evening on working days:

- Monday (Morning and Evening)
- Thursday (Morning and Evening)

Composition of Traffic:

Gate#1:

Only cars were allowed to pass through Gate#1 at the time of collection of data. Two E-tag lanes and one manual check lane is provided on the entrance and same are given for the exit of Traffic.

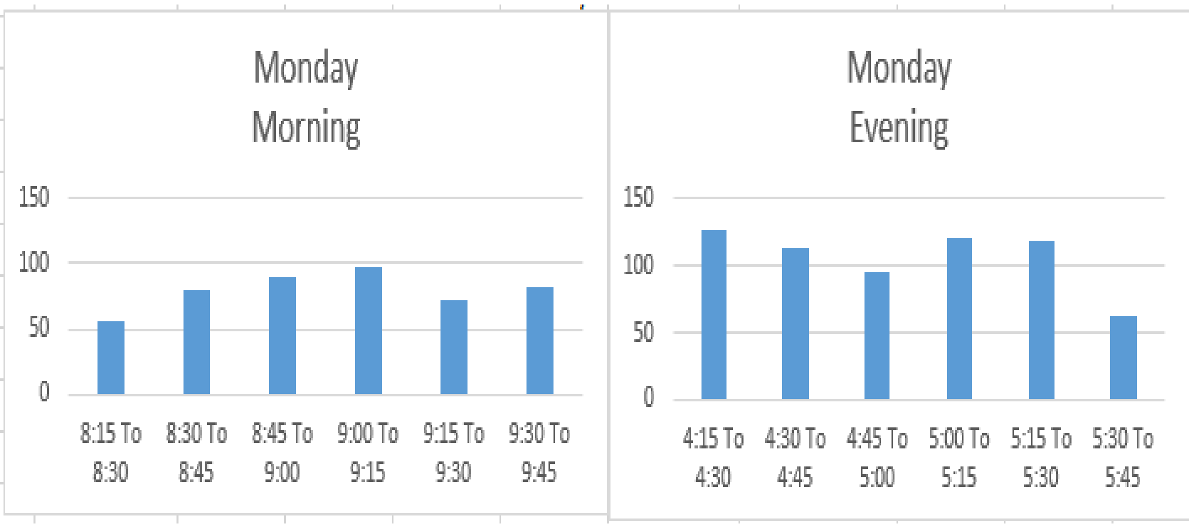


Fig. 54: Gate#1 Design Traffic Composition Data (Monday)

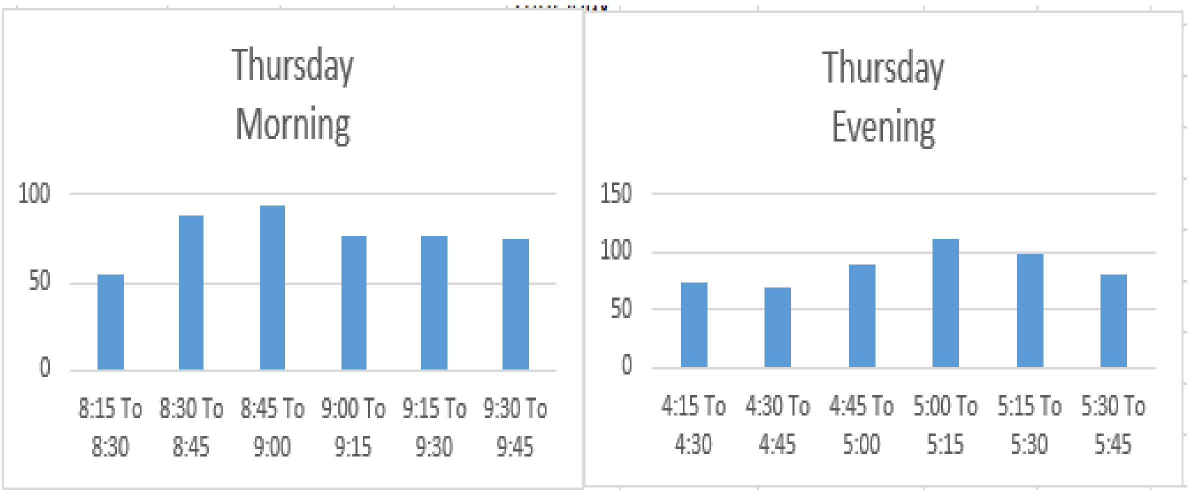


Fig. 55: Gate#1 Design Traffic Composition Data (Thursday)

Gate#2:

Every Type of vehicle mentioned above was allowed to pass through Gate#2 including Cars, Motorbikes and Buses/Wagons at the time of collection of data. Two manual check lanes are provided at entrance and exit of the Gate.

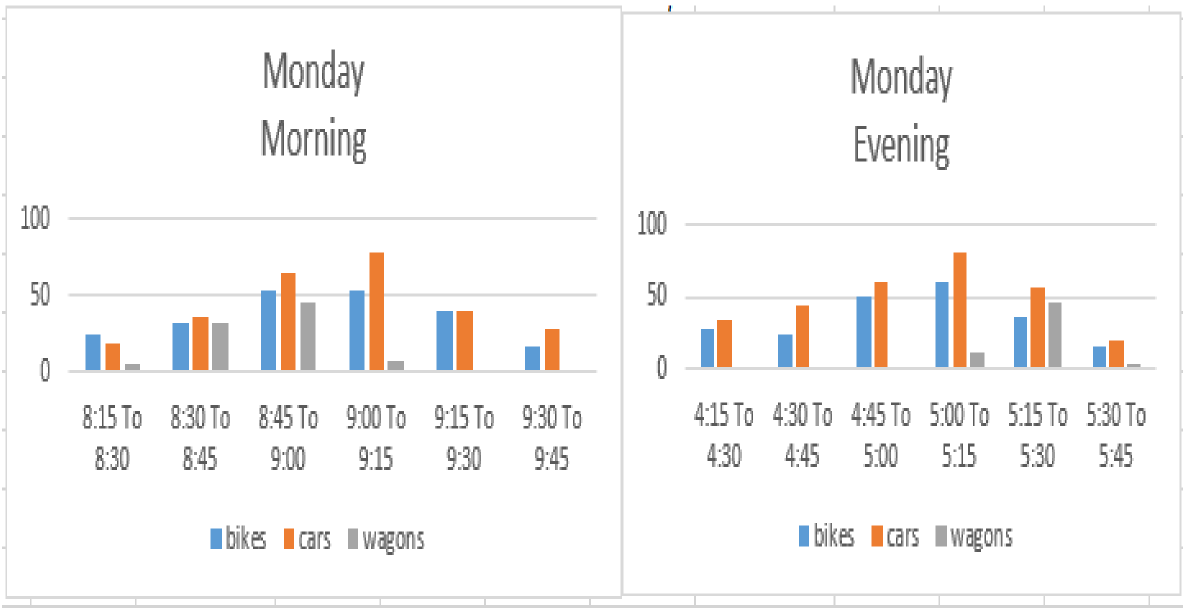


Fig. 56: Gate-2 Design Traffic Composition Data (Monday)

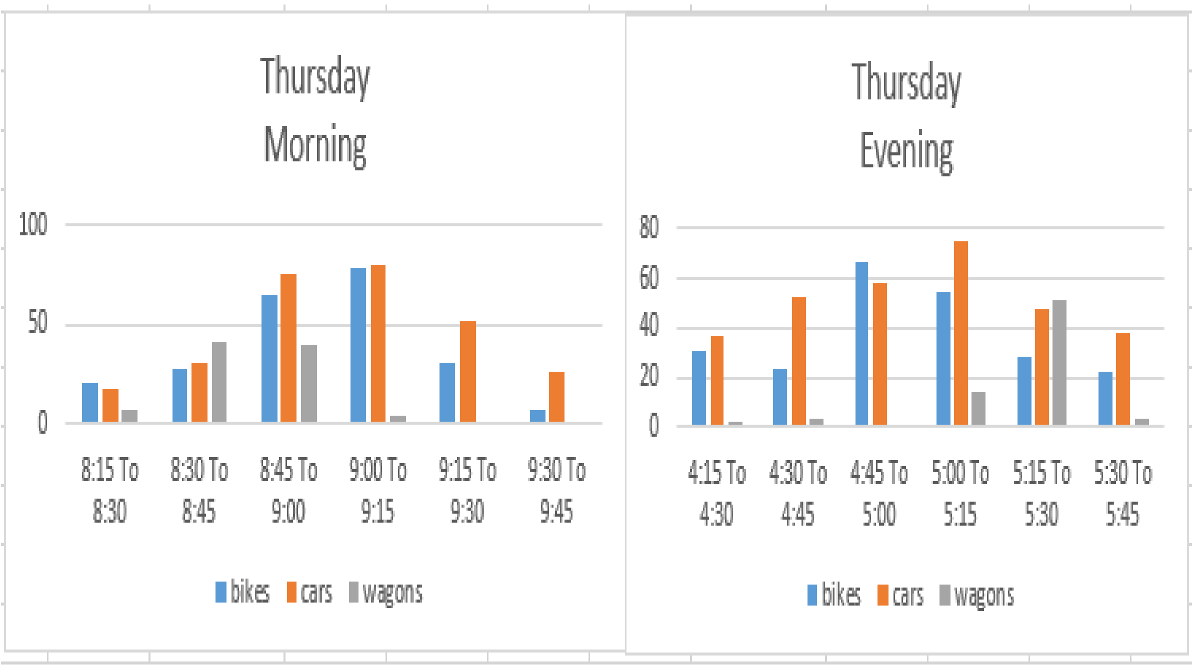


Fig. 57: Gate-2 Design Traffic Composition Data (Thursday)

Gate#10:

Every Type of vehicle mentioned above was allowed to pass through Gate#10 including Cars, Motorbikes and Buses/Wagons at the time of collection of data. One manual check lanes are provided at entrance and exit of the Gate.

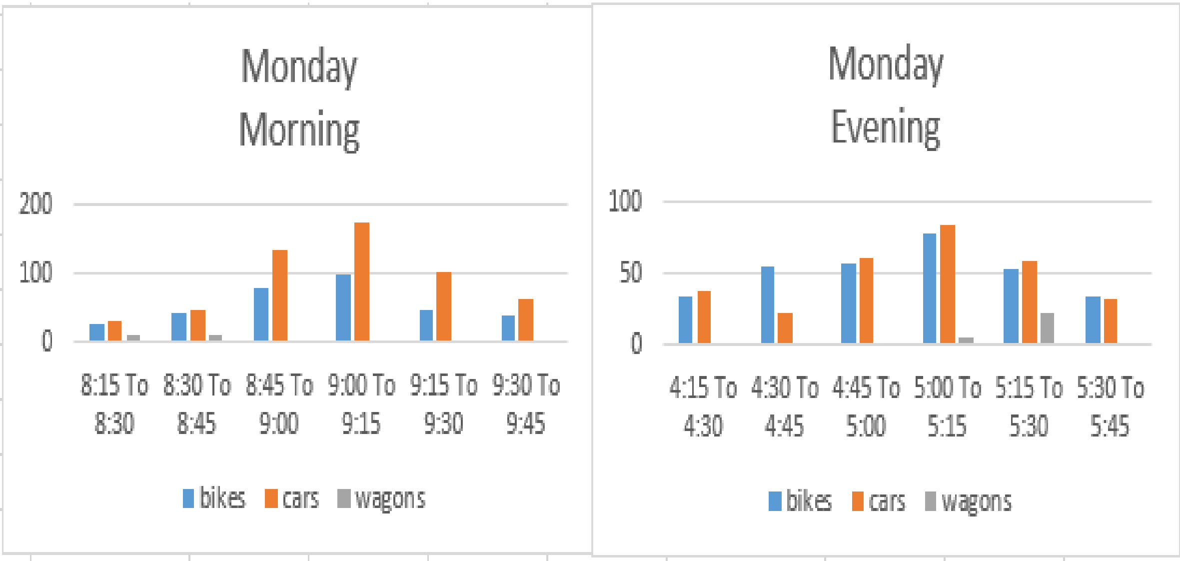


Fig. 58: Gate-10 Design Traffic Composition Data (Monday)

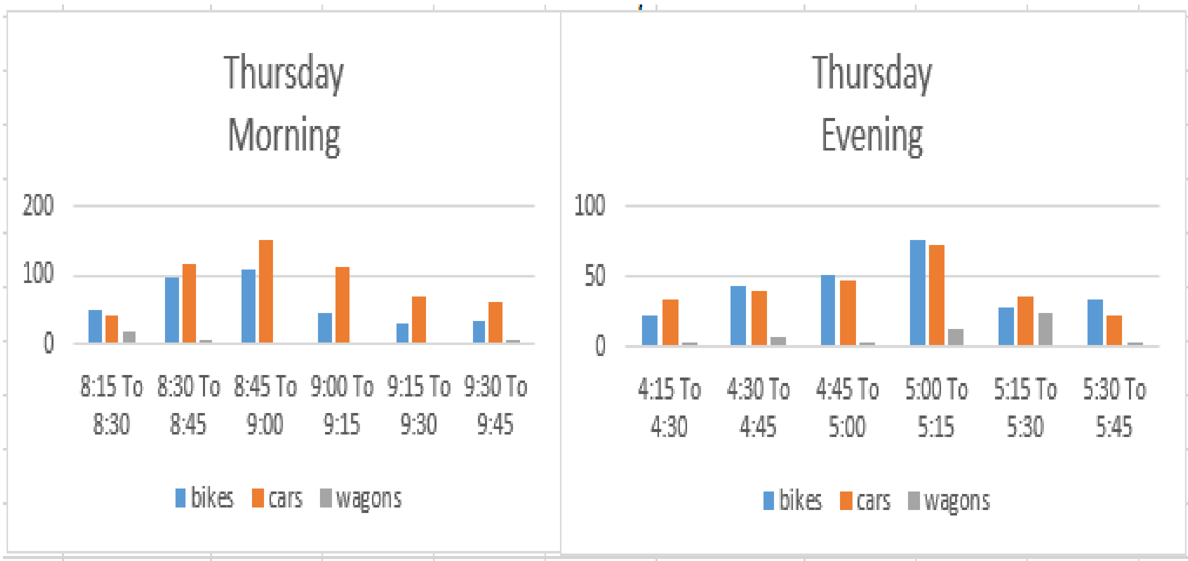


Fig. 59: Gate-10 Design Traffic Composition Data (Thursday)

Changes of composition of vehicles in the new design:

- Gate#10 would be restricted to only cars passage.
- All types of vehicles would be involved in passing through Gate#1 which includes cars, motorbikes and buses/wagons.

6.3 Average Delay Time for a Vehicle

Time delay is outlined because the time a vehicle is stopped in queue whereas waiting to pass through the intersection. It begins once the vehicle is completely stopped and ends when the vehicle begins to accelerate. Average time delay is the average for all vehicles throughout a specific time amount.

Average Time Delay for a vehicle is calculated by using Software (VISSIM).

Existing Design:

Gate#1:

Delays are calculated at Gate#1 for the given data.

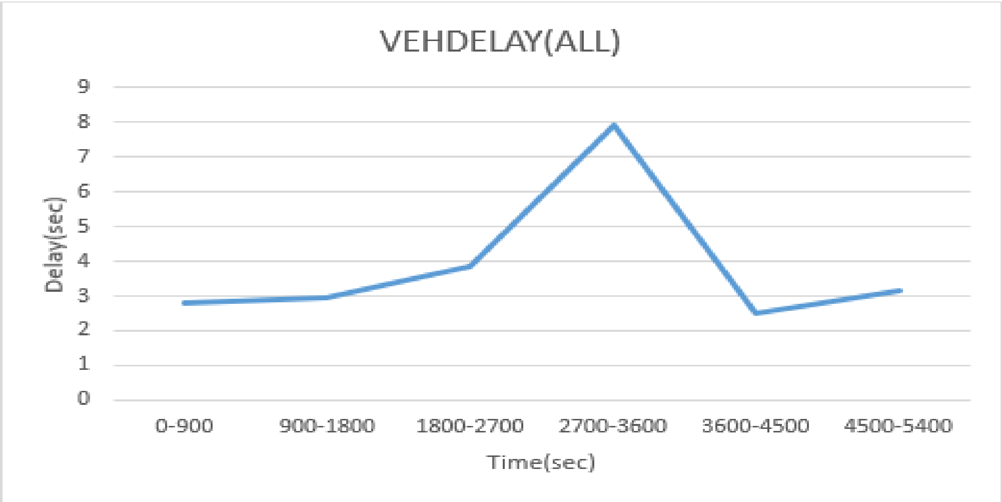


Fig. 60: Gate-1 Avg. Vehicle Delays Graph (Existing Scenario)

Gate#2:

Delays are calculated at Gate#2 for the given data.

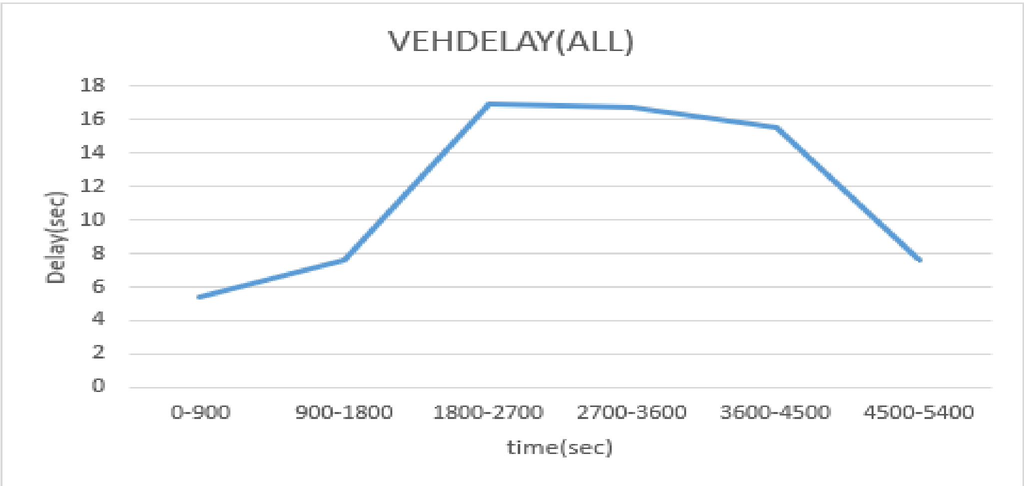


Fig. 61: Gate-2 Avg. Vehicle Delays Graph (Existing Scenario)

Gate#10:

Delays are calculated at Gate#10 for the given data.

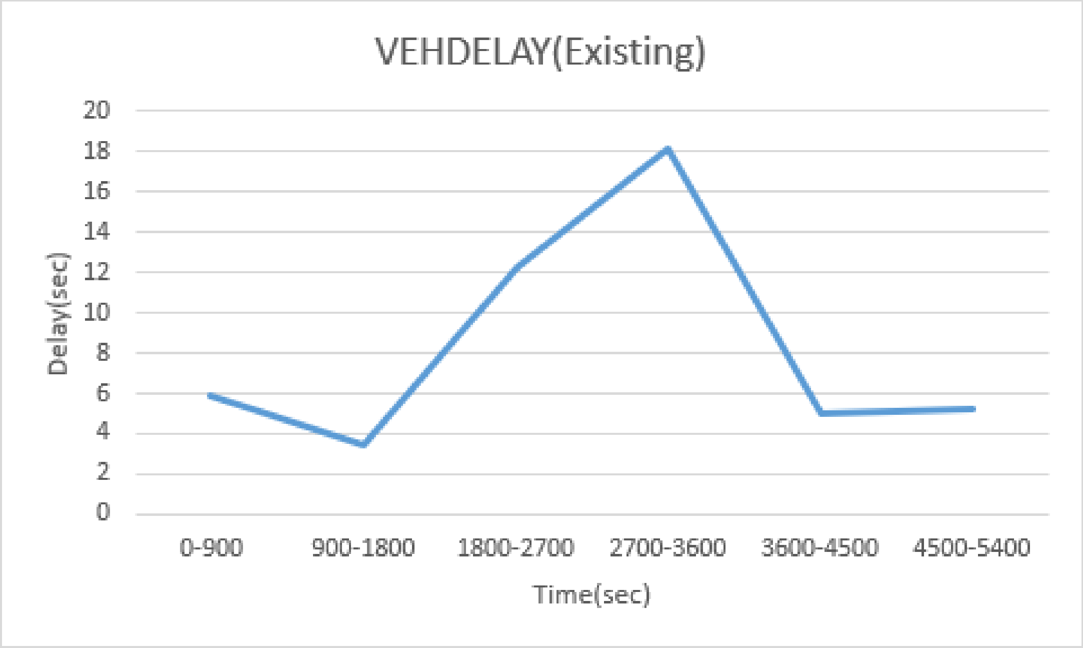


Fig. 62: Gate-10 Avg. Vehicle Delays Graph (Existing Scenario)

Proposed Design:

Gate#1:

Delays are calculated at Gate#1 for the Proposed data.

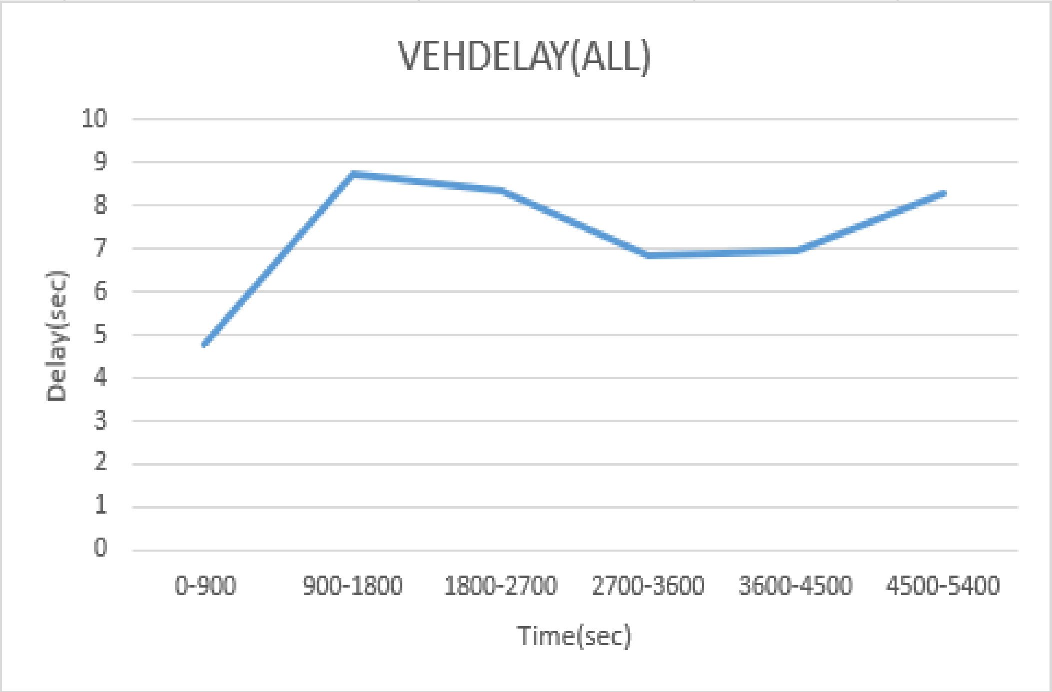


Fig. 63: Gate-1 Avg. Vehicle Delays Graph (Proposed Scenario)

Gate#2:

Delays are calculated at Gate#2 for the Proposed data.

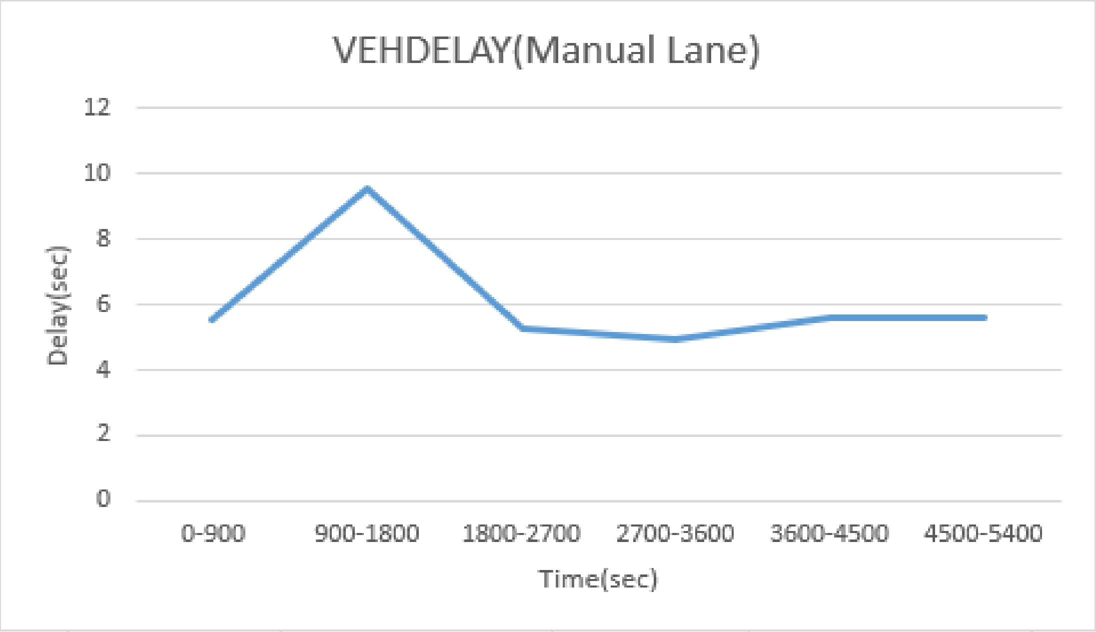


Fig. 64: Gate-2 Avg. Vehicle Delays Graph (Proposed Scenario)

Gate#10:

Delays are calculated at Gate#10 for the Proposed data.

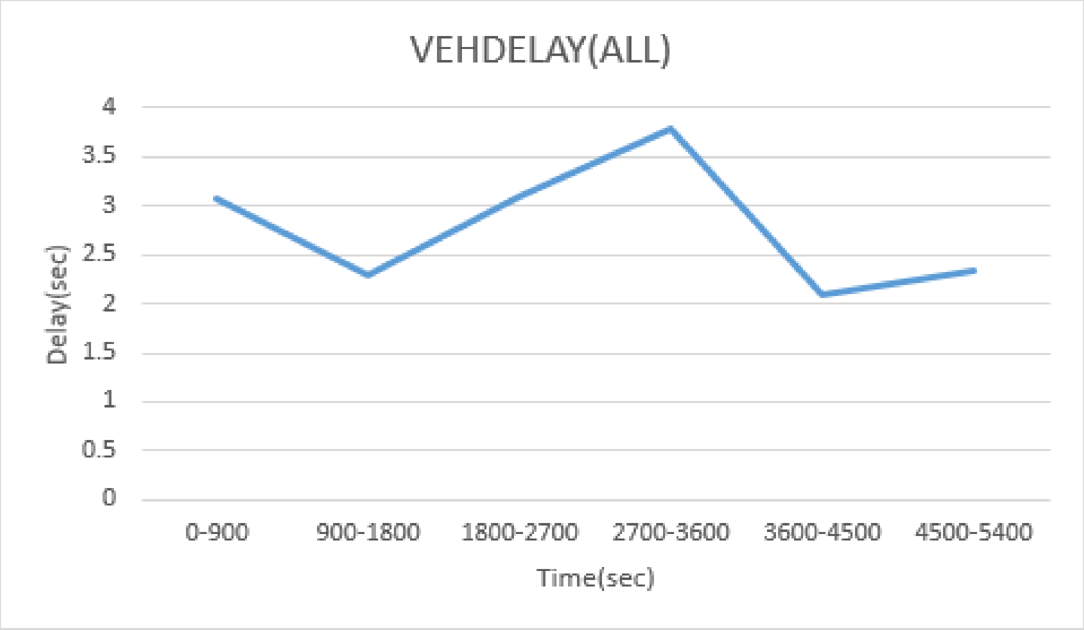


Fig. 65: Gate-10 Avg. Vehicle Delays Graph (Proposed Scenario)

6.4 Queue Length:

According to the Highway Capacity Manual, queue is defined as “a line of vehicles, bicycles, or persons waiting to be served by the system in which the flow rate from the front of the queue determines the average speed within the queue.

Queue Length is calculated by using software (VISSIM).

Existing Design:

Gate#1:

Queue Lengths are calculated at Gate#1 for the Given data.

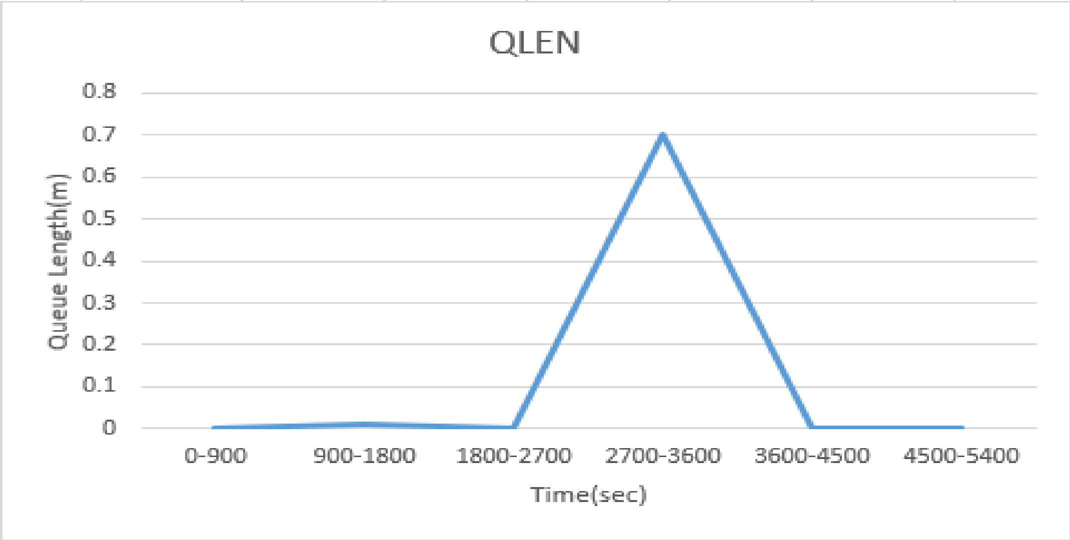


Fig. 66: Gate-1 Max. Queue Length Graph (Existing Scenario)

Gate#2:

Queue Lengths are calculated at Gate#2 for the Given data.

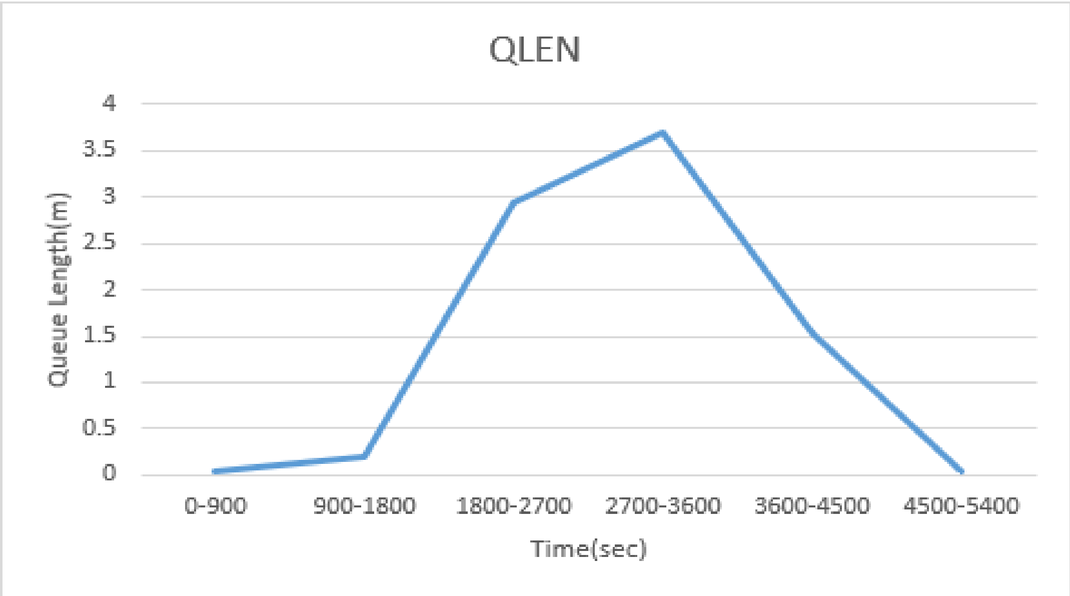


Fig. 67: Gate-2 Max. Queue Length Graph (Existing Scenario)

Gate#10:

Queue Lengths are calculated at Gate#10 for the Given data.

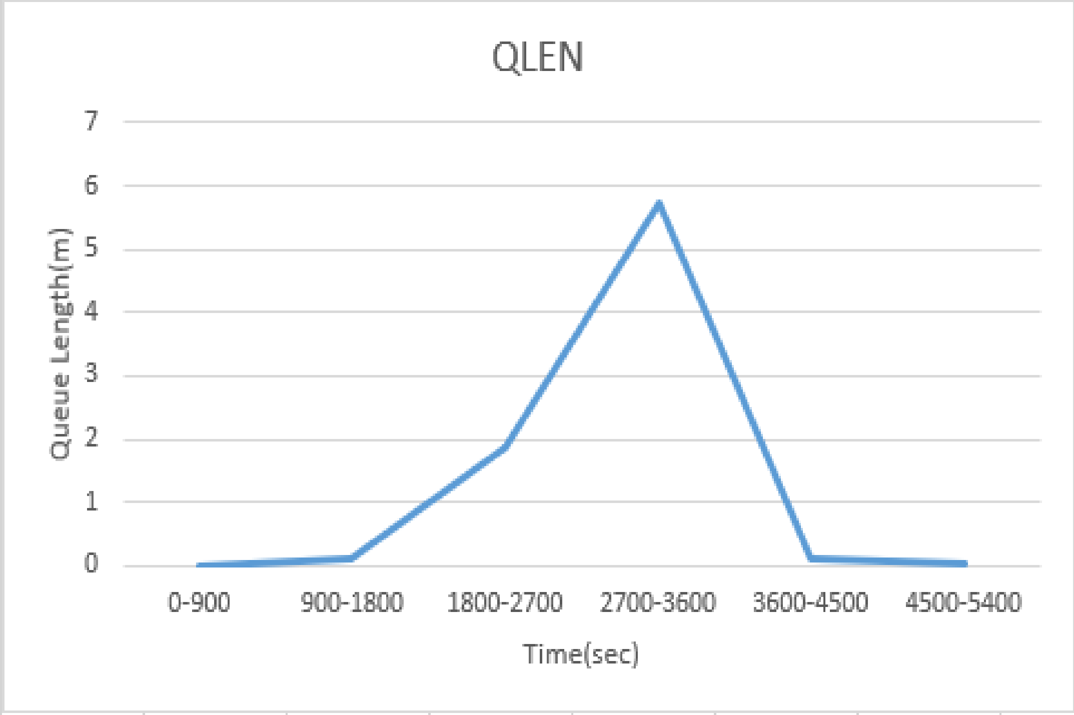


Fig. 68: Gate-10 Max. Queue Length Graph (Existing Scenario)

Proposed Design:

Gate#1:

Queue Lengths are calculated at Gate#1 for the Proposed data.

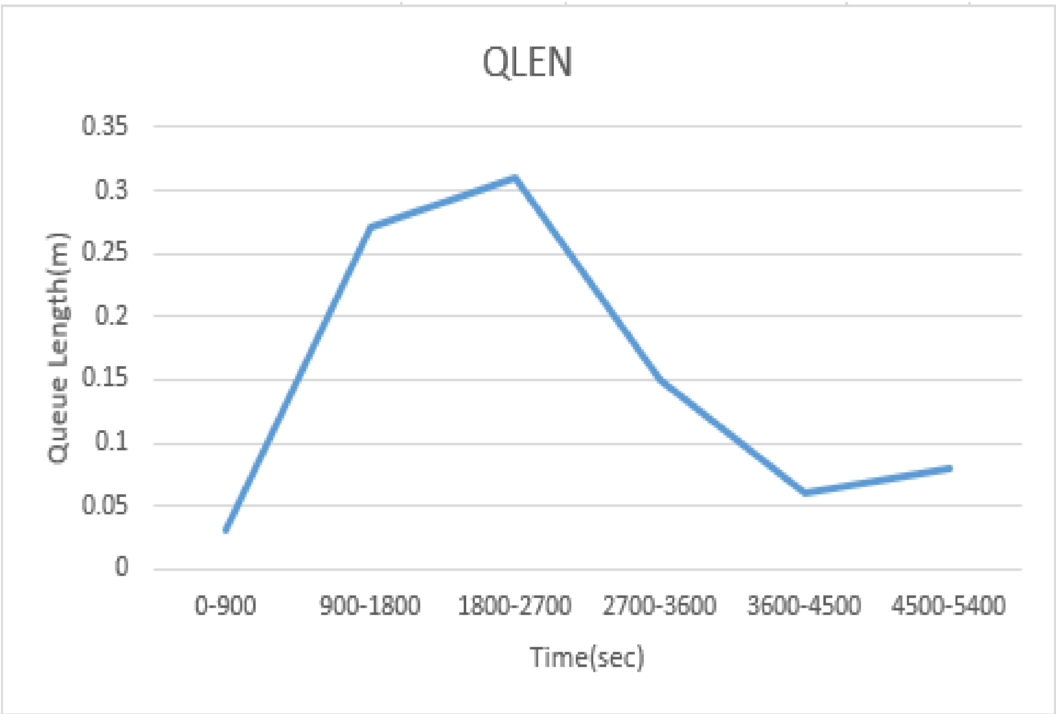


Fig. 69: Gate-1 Max. Queue Length Graph (Proposed Scenario)

Gate#2:

Queue Lengths are calculated at Gate#2 for the Proposed data.

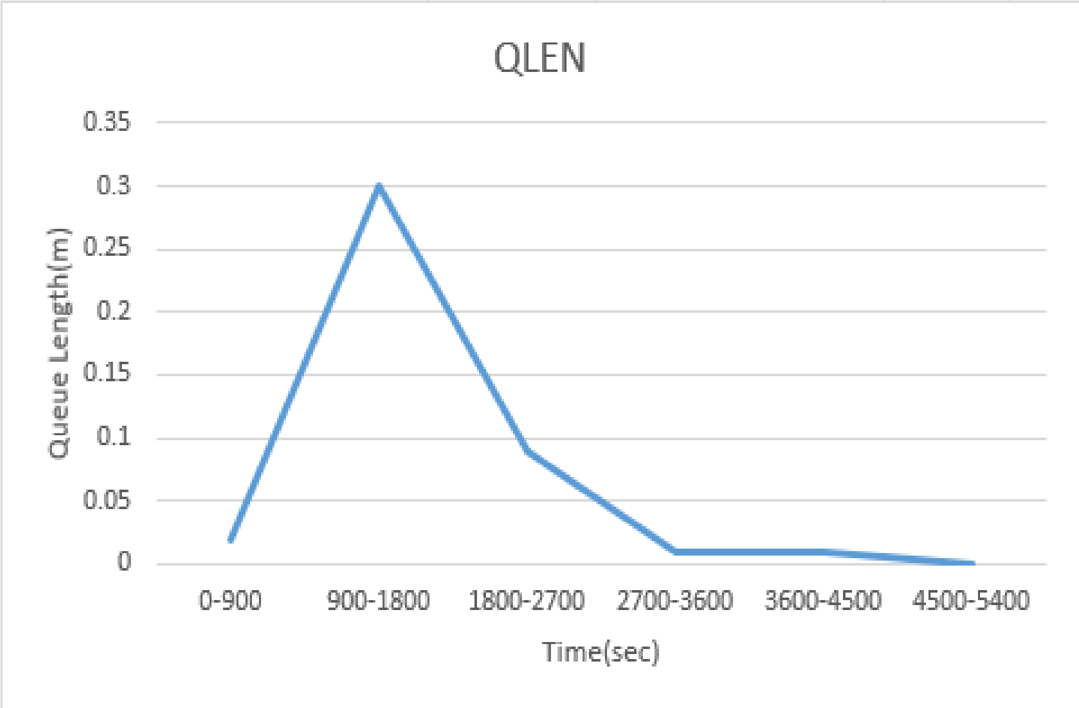


Fig. 70: Gate-2 Max. Queue Length Graph (Proposed Scenario)

Gate#10:

Queue Lengths are calculated at Gate#10 for the Proposed data.

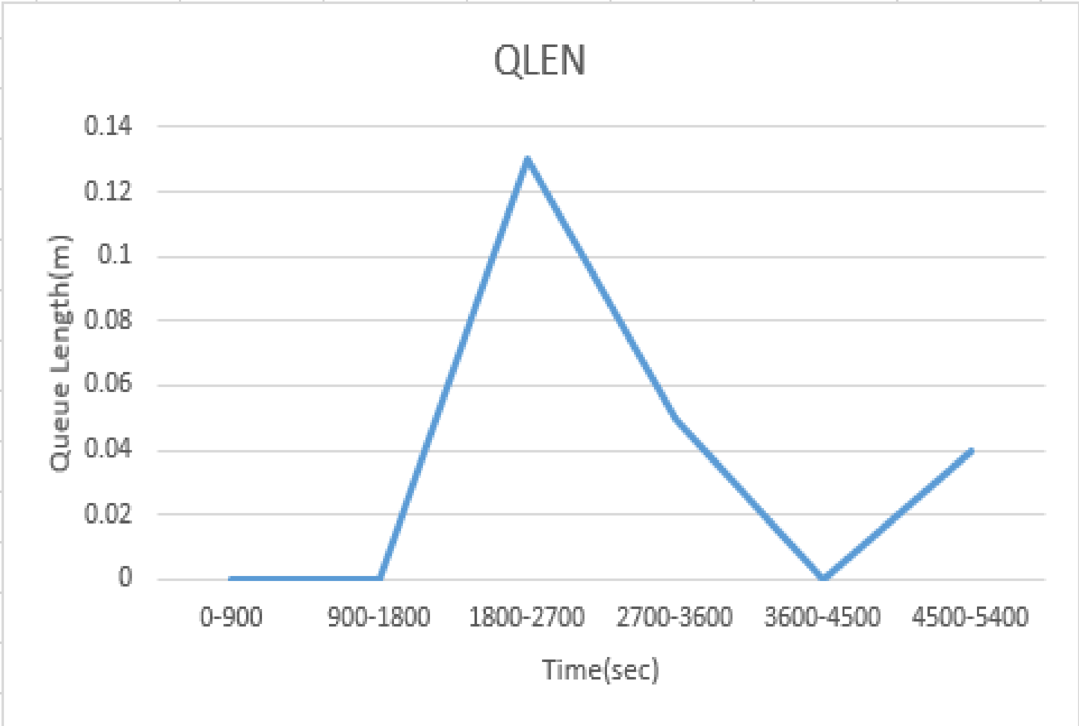


Fig. 71: Gate-10 Max. Queue Length Graph (Proposed Scenario)

6.5 Visual Interpretation of Traffic after Simulation

VISSIM is one of the advanced software regarding modelling the Traffic Features. Along data analysis, we can graphically create a simulation of Traffic converting it into a video. Likewise, we used this software to make a simulation of traffic passing through the University Gates.

It is a visionary key to visualize the behavior of vehicles. We have worked on both Existing Design and Proposed Design.

We can see queue formation on congestion points resulting in Time delays for vehicle to pass. Reduction of queue formation can be seen in the simulation after applying our solution analysis.

6.6 Discussion on Results

Analysis are done to obtain productive results. Existing Situation has been analyzed then compare with the analysis of a new design. Some changes have been done with the composition of traffic as mentioned before which would incur in new design.

6.6.1 Queue Length

Comparison has shown below:

Gate#1:

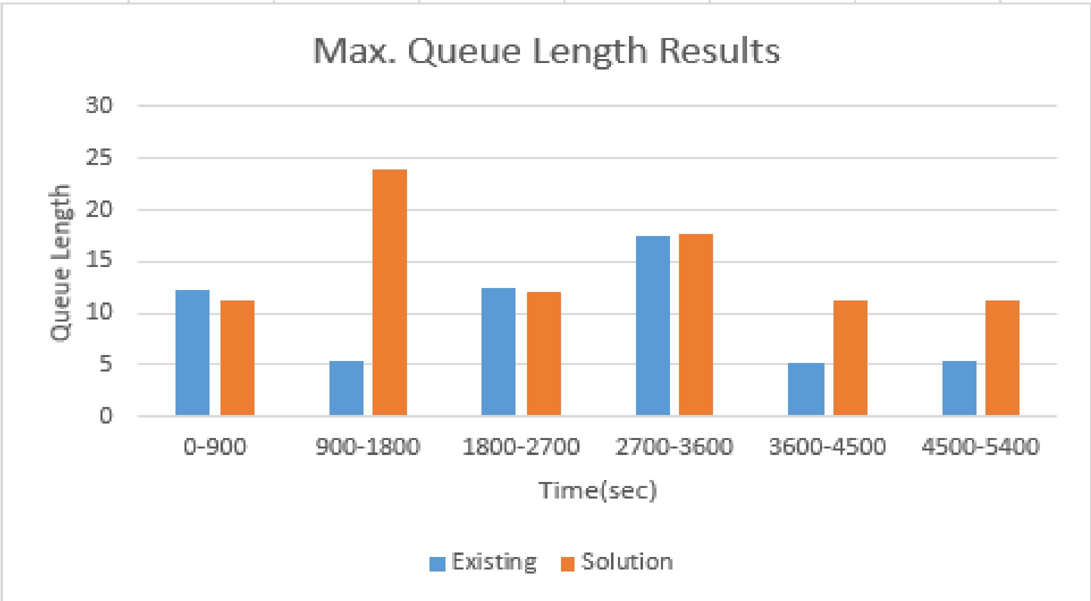


Fig. 72: Gate-1 Max. Queue Length Result Comparison

Graph shows increment in queue length, it’s because of change in composition of traffic but it is less than the queue generation on gate#10 as all type of traffic was encountered through Gate#10.

Gate#10:

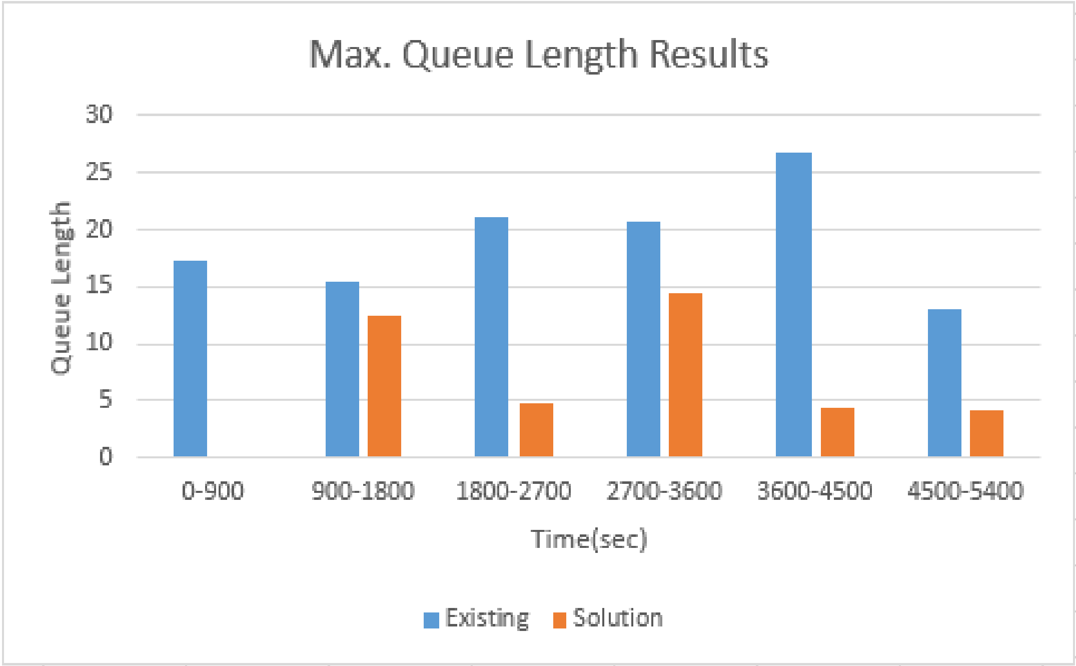


Fig. 73: Gate-2 Max. Queue Length Result Comparison

Gate#2:

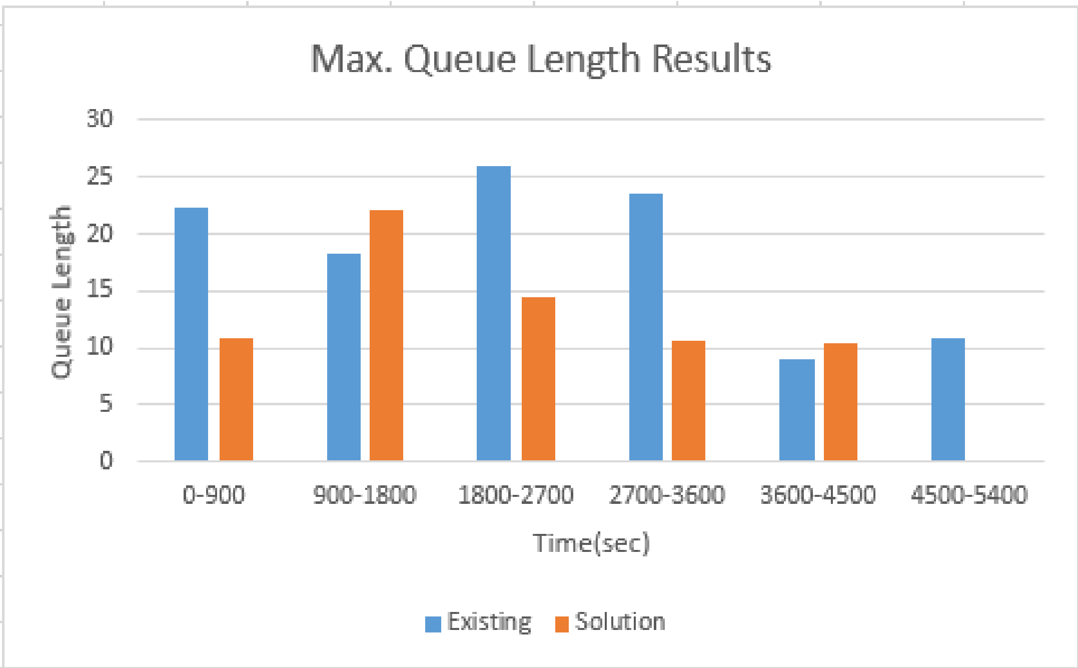


Fig. 74: Gate-10 Max. Queue Length Result Comparison

Overall effect of reduction in queue lengths can be seen from the graph.

6.6.2 Delay Time

Comparison has shown below:

Gate#1:

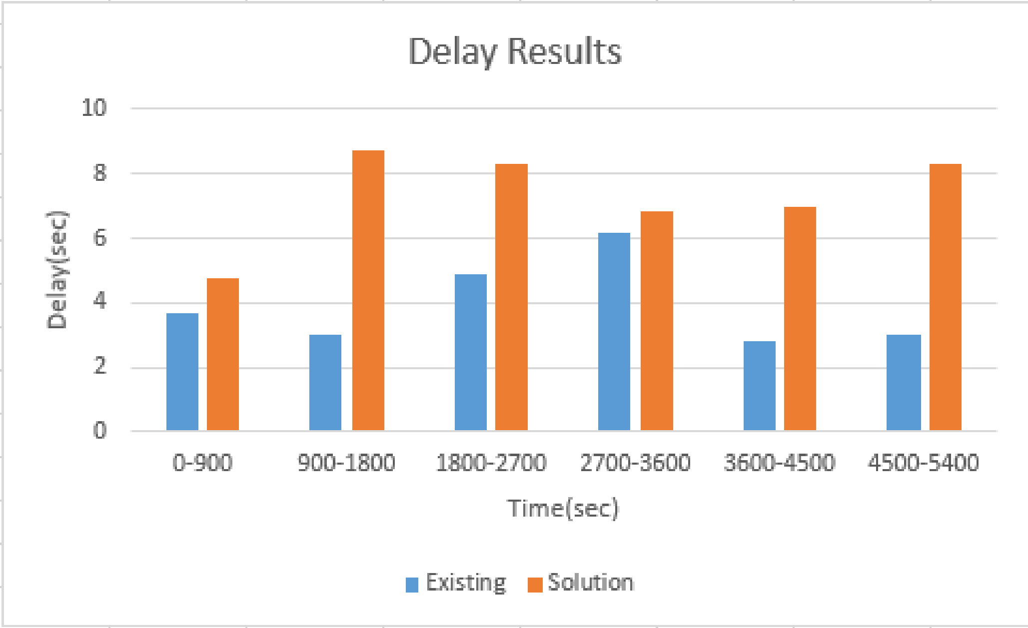


Fig. 75: Gate-1 Avg. Queue Length Result Comparison

Graph shows increment in Delay Time, it's because of change in composition of traffic but it is less than the delays on gate#10 as all type of traffic was encountered through Gate#10.

Gate#10:

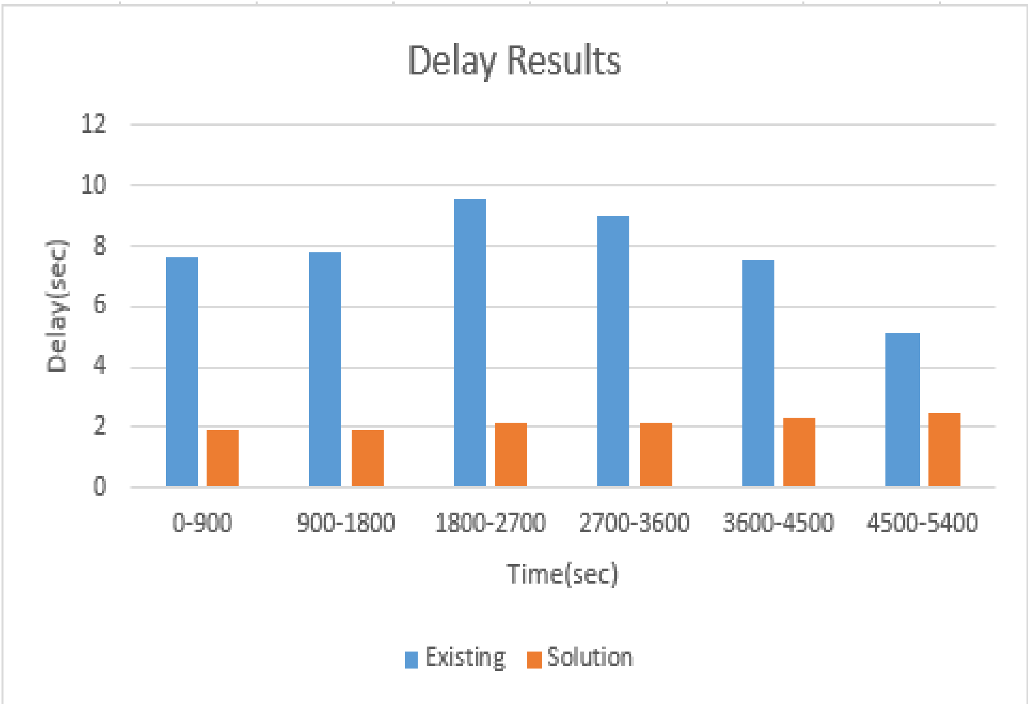


Fig. 76: Gate-2 Avg. Queue Length Result Comparison

Gate#2:

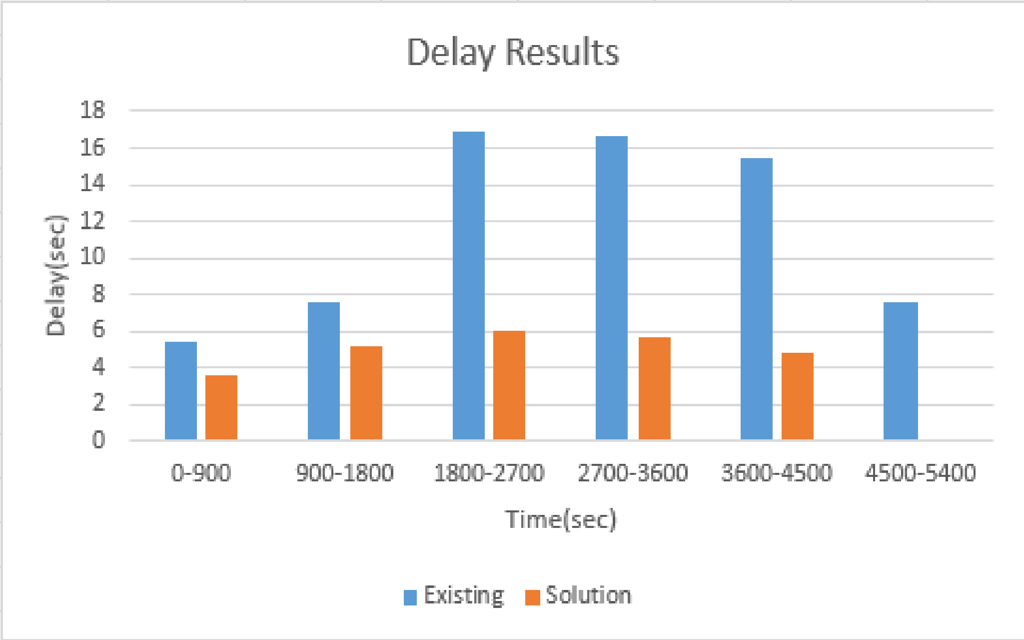


Fig. 77: Gate-10 Avg. Queue Length Result Comparison

Overall effect of reduction in delay time can be seen from the graph.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Transportation is a key factor in developing countries. Transitional economies enjoy the convenience of automobile transportations. Automobile transport stimulates the flow of people, freight and information, helping to meet economic, industrial and social demands. However, increasing use of automobiles also causes problems including traffic congestion, road accidents and air pollution.

ITS solves the congestion problems by introducing technologically advance approaches. ITS have great potential for improving surface transportation and for delivering benefits to everyone who uses the transportation system. ITS avoids pitfall and risks and move forward quickly and economically.

Geometric design helps improve the traffic flow and to optimize the efficiency while minimizing the environmental hazards. Proper channelization reduces the conflicting zones and reduce the speed on a road section.

The project helped in solving the traffic problems at entrance gates of NUST by implementing ITS, geometric design changes, traffic distribution and applying traffic calming techniques. Entrance gates at NUST needs some design changes due to the increased number of vehicles in the campus. Therefore, the problem was solved by re-designing and re-routing of the traffic network along with the use of ITS. Some minor design changes, proper channelization and the right use of technology helped us in reducing the queue lengths during peak hours. The entrance gates are not fully utilizing the power of advanced technology due to which we see the problems faced by drivers and passengers.

At the end of this project, we concluded that the use of above-mentioned techniques reduced the traffic congestion, increased the serviceability and server utilization improved significantly and ultimately reducing the total delay and travel times for a vehicle. It is important to use the technology rightfully rather than just implementing it.

Recommendations

- The future of transportation relies on advanced technologies and therefore ITS is in integral part of the system. Future studies in ITS may help for a better solution for congestion mitigation. It is a field which is ever evolving and the need of the hour.
- In this project, there are a few recommendations which are necessary for the proposed system to work efficiently.
- First of all, proper channelization is needed so that the traffic on the entrance gates move smoothly without interruption.
- Vehicle distribution should be done according to the criteria mentioned.
- Finally, university vehicles should register their cars with E-Tag as soon as possible to avoid inconvenience without any hassle. Also, there is no need for E-Tag on exit gates.

REFRENCES

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- "Tackling congestion on our roads". Department for Transport. Archived from the original on 2008-04-23. www.web.archive.org/web/20080423050200
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