BE CIVIL ENGINEERING
PROJECT REPORT

IMPROVING TRAFFIC PROGRESSION AT 12TH AVENUE ISLAMABAD USING VISSIM SIMULATIONS

Project submitted in partial fulfillment of the requirements for the degree of

BE Civil Engineering

SUBMITTED BY

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ABSTRACT

The urban roads/ highways of today's large metropolitan cities are operating close to capacity. Spatial limitations and projected future demand imply introducing measures and interventions for the optimal use of the existing space that provide the best level of service for urban travelers. Islamabad being the capital and center of economic activities attracts traffic from all over the country. Over the years, Rawalpindi and Islamabad have expanded and practically merged as twin-cities causing urban traffic congestions. Volume of traffic commuting between Rawalpindi and Islamabad is tremendous and is increasing at a rapid pace, and is expected to cause traffic jams, interruptions, traffic safety hazards and more fuel consumption. To counter such effects, major and minor interventions i.e. signal timing optimizations, coordinated signal controllers, adding more lanes to existing roads, introducing grade-separated facilities (flyover or an underpass) has been the traditional response and considered important strategies for alleviating congestion and managing the increase in traffic demand.

In this project, traffic analysis study was carried out at 12th avenue Intersection Islamabad to evaluate its existing and future scenario conditions. Traffic survey included the traffic volume count, signal cycle length and intersection inventory/ geometrics study. The current intersection layout was modelled in urban traffic simulation software VISSIM and the peak hour volumes exhibited 12th avenue as a crowded intersection performing at poor level of service. Two different grade-separated intersection alternatives were modelled and presented using VISSIM software for improving the current traffic progression at this intersection. Considering the traffic growth and projected demands in future scenarios, the proposed design minimizes the delays, queue length, environmental hazards and are considered economically feasible exhibiting acceptable level of service for urban travelers. The purpose of this project was to evaluate and improve the existing traffic situation at the selected intersection and provide efficient, safe and fast traffic operations for the future.

ACKNOWLEDGMENTS

All thanks and praises be to Allah Almighty, the Lord, the Creator, and the Sustainer of the Universe, Who taught knowledge to his human beings, and guided us to complete our research successfully.

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A very special thanks to our parents for their best wishes and prayers which brought us all the successes in this life. We are forever indebted to their lifelong struggles and sacrifices for our wellbeing of all sorts. May Allah Almighty bless them and bestows his countless bounties and blessings on them.

Contents

Chapter 1

INTRODUCTION

1.1 General

It is accepted at global level that transportation plays a vital and pivotal role in a country's growth economically and industrially. Level of transportation and communication often determines a country’s economic growth. Developed countries pay a lot of attention towards this area and it is a major part of their growth and development. Transportation also plays an important role towards the improvement of production capacity of a country and makes it self-efficient.

Traffic congestion hinders traffic progression and also countries progress towards economic growth. Traffic congestion is caused by many reasons. Some of the main reasons are:

- Traffic volume demand greater than the capacity of a highway.
- Accidents, vehicle failures.
- Parking of vehicles at no-parking facilities.
- Non-regulated intersections.
- Signalized intersection not designed properly.

Traffic progression is major concern in major cities of developing countries due to rapid growth of population and ultimately traffic. Urban and town planning is little to none in developing countries which tend to create many problems for traffic engineers and planners. Pakistan is also affected by the situation equally and struggling to overcome the situation. Planners and developers are left with very few options to overcome the situation created by high traffic volumes and exceeding the capacity of a highway or any intersection. Few options often considered by the traffic Engineers and professionals are Providing a median, expanding roadways, providing signal controllers, etc. these options often provide a short term solution to the problems. Long term solutions to improve traffic progression are very costly and provide proper planning. Grade separated facilities at intersections and providing a mass transit system at congested urban arterials often solve the issue for a long term and may improve traffic progression of an urban highway.

1.2 Background

Twin Cities (Islamabad and Rawalpindi) are two major cities of Pakistan. These two cities have a combined population of around 4 Million. These two cities are growing with an alarming rate. Islamabad and Rawalpindi has a growth rate of 5% and 4%

respectively. Growth in population means growth in transportation demand which ultimately cause traffic congestion if not dealt with effectively.

Mass transit systems are planned and being constructed in phases to overcome the congestion of major arterials including Kashmir highway and Murree Road. First line named as Red Line from Flashman Hotel (Rawalpindi) to Pakistan Secretariat (Islamabad) which has already been completed and successfully under operation. Orange Line from G.T Road (N-5) to Constitution Avenue along Kashmir Highway is selected for construction. This will help control the congestion at Kashmir highway at peak hours and help reduce the delay due to long lines and blockage of traffic at certain intersections.

Kashmir highway is a major arterial of twin cities. It has huge importance because it connects Islamabad and Rawalpindi and is also a link to motorway and G.T Road and for travelers traveling outside twin cities. The fact that it is connecting two cities was enough to cause congestion but being a link for motorway is making things worse. It is a 5 lane a side divided highway with a design speed of 80kmph. The major delay comes at intersections where at peak hours the delay at a signalized intersection sometimes exceeds 10 minutes per vehicle.

1.3 Problem Statement

Traffic congestion is one of the serious issues in developing countries. With cities growing at an alarming rate, traffic congestion in Islamabad – Rawalpindi is becoming a major problem.

Conditions at Kashmir highway and specifically at 12th avenue were analyzed using VISSIM. As Kashmir highway is a major arterial linking Islamabad and Rawalpindi. Congestion at this intersection is caused by the traffic bound towards Islamabad and Rawalpindi. Traffic from H-sector and G-sector ads on to the situation as it is a four-leg intersection and is crossing at grade. National university of sciences and technology is also located in the vicinity of 12th avenue. The traffic from university in morning and at the break-off times is also hindering traffic progression. Sectors G11 and G12 are growing at an alarming rate and this will cause blockage of intersection in the near future. Traffic congestion causes lengthy queues and vehicle delays frustrating the passengers using the intersection facility.

Therefore, it is necessary to find a solution of this intersection before it causes the blockage of the Kashmir highway. Motivation of our study was to provide economical solutions keeping in mind current and future traffic volumes on the intersection.

1.4 Objectives

Our objectives are as follows:-

- To analyse traffic conditions at 12th avenue intersection in order to evaluate the traffic progression at 12th avenue Islamabad using traffic simulation software (VISSIM).
- To suggest minor interventions and remodelling of infrastructure for the improvement of level of service of the Intersection.

1.5 Scope

Our Project focuses on the analyses of an intersection which includes data collection and simulation of traffic on VISSIM 9. It also encompasses a solution to improve the traffic progression of the intersection and reduce the delays suffered by the travelers. For this purpose PTV VISSIM 9 was used.

PTV VISSIM 9 is very vast software and uses different type of traffic data to analyze an intersection and provides a variety of solutions for the existing problems. To select an appropriate solution is a difficult and complicated task. This requires a lot of experience and expertise in the field.

1.6 Organization of the Report

This report includes the results and findings of our project in 7 chapters. Chapter 1 includes: Introduction to the study i.e. background, problem statement, objectives and scope. Chapter 2 includes: Literature Review of the project includes types of intersection and two similar case studies of intersection. Chapter 3 Includes: Methodology of the project i.e. the sequence followed to reach the end product of our study. Chapter 4: it includes an introduction to VISSIM 9®; software used to analyze the intersection. The chapter provide a basic guide to the software and few of the major functions of VISSIM 9®. Chapter 5: This chapter analyses the data collected for existing conditions at 12th Avenue using VISSIM 9®. Chapter 6: This chapter discusses the proposed solutions to the traffic congestion at 12th avenue. It includes minor interventions and major infrastructural changes. It also compares the solutions. Chapter 7: Conclusion and Recommendations. This chapter includes the conclusion drawn from the study and recommendations proposed for the future.

Chapter 2

LITERATURE REVIEW

2.1 Introduction

This chapter comprises of the various studies and researches that have been carried out in the past in the field of traffic congestion, traffic conditions, their effects on intersections and calculation of level of service of an intersection. In this chapter various design methods will be discussed that will help us reduce delays on intersections. Moreover, the last segment of this chapter emphasizes on the design and alignment of a new freeway.

2.2 Traffic Congestion

Traffic congestion also known as traffic jam is a major concern of metropolitan areas, as it results in slower speeds, longer trip times and increased vehicular queuing. Various steps are undertaken to reduce the traffic congestion. The first step in this whole process is the identification of the congestion and its various features to direct us for the selection of suitable and requisite measures. Congestion not only retards the movement of personnel; it also adversely effects the traffic circulation on various intersections. In 1994, Vuchic and Kikuchi articulated the definition of congestion as:

> "*When vehicular volume on a transportation facility (street or highway) exceeds the capacity of that facility, the result is a state of congestion.*"

Traffic congestion wastes time, elevates stress levels among the people as well as increasing the cost of travelling of the society along with the increase in pollution. Numerous causes which generate congestion include:

- Number of vehicles exceeding the design capacity.
- Blockade on the roadway.
- Inadequate intersection cycle length.
- Traffic signal malfunction.
- Excessive pedestrian crossing.
- Increase in vehicle ownership causing limited use of mass transit system.

Congestion is the imbalance in supply and demand for road spaces. There are limited options for building the way out of congestion. The best possible way for congestion reduction is to optimize our intersections particularly for peak hour traffic. Another measure for reducing congestion is demand management such as high occupancy vehicle lanes and mass transit system. It is therefore essential to distinguish both types of measures. Primary elements influencing the* supply side of transportation are:

- Capacity i.e. the total roads and the number of lanes.
- Optimizing the road network such as optimizing signals.
- Number of accidents or road works.

At times it is difficult to increase the capacity of the existing road network; therefore the traffic management is being influenced by the last two factors. Thus, traffic management optimizes the supply-side of the road network.

2.3 Intersection Delays

Intersections in the urbanized road network perform a key role in the application and operation of the traffic system. Intersections have been classified into two main groups i.e. at grade and grade separated. There are three different levels of intersection control. An intersection can either be completely controlled (automated), semi controlled or uncontrolled. In case of controlled intersection, the roadway width for all the traffic flows remains the same and the factor which controls the various streams is the signal time. The factors which are used for the assessment of signalized intersection are capacity, volume-to-capacity ratio, delay, and queue length.

2.3.1 Capacity

Capacity is defined by Highway Capacity Manual (HCM) as the maximum hourly rate at which vehicles can be expected to traverse a point or a uniform segment of a length/roadway during a given time period. It is evaluated using saturation stream values. Capacity elucidates various roadway conditions such as, grades, and lane use allocations, the number and width of lanes as well as signalization conditions. Capacity is normally calculated for critical lane groups (lanes requiring maximum green time).

2.3.2 Volume/Capacity ratio

It is the ratio between the vehicular demand and the roadway capacity. For intersections v/c ratios for all the lanes is calculated and the lane having the maximum v/c ratio (critical lane) is considered. It is also regarded as degree of saturation. V/C ratio less than 1 specifies that the traffic on the road is less than the capacity and the vehicles will not experience any queues or delays. V/C ratio equal to 1 may cause unstable traffic conditions i.e. delays and queuing. Whenever the vehicular demand is greater than the capacity i.e. v/c ratio is greater than 1, extreme delays and long queues are generated and is generally referred as cycle failure. While designing, a volume/capacity ratio between 0.85 and 0.95 is usually measured for peak hour flow.

2.3.3 Delay

Delay is the extra time that a driver or a passenger experiences. Delay includes start up lost time, queue time as well as the clearance lost time. Delay can be calculated by the following equation:

$d = d1fp + d2 + d3$ ………………………………………………………….. (1)

Where:

d1: is uniform control delay (d1 ≡ du),

fp: is uniform delay progression adjustment factor,

d2: is incremental delay, and

d3: is initial queue delay, which estimates the additional delay due to an initial queue at the beginning of an analysis period.

The incremental delay is:

d2 = 900T (X − 1 + ((X − 1)2 +8kIX/cT) 0.5) ………………………………. (2)

Where:

T: is the length of the analysis period (hours),

k: is the incremental delay factor that is dependent on controller settings, and

I: is the upstream filtering/metering adjustment factor.

Factors effecting controlled delay are volume of the lane group, capacity of the lane group, cycle length and effective green time. Delays ultimately affect the level of service of the roads.

2.3.4 LOS

Level of service (LOS) is a qualitative measure which is used to relate the quality of traffic service by transportation planners on transportation devices, or infrastructure. LOS is a more holistic approach, even though the traveler is more interested in the speed of his vehicle. Due to this, LOS is referred as a measure of traffic density and is used to examine highways by classifying the flow of traffic and allocating quality levels of traffic based on the performance measures like density, speed etc. It is also linked to transportation time, with lesser the time, the better LOS.

LOS is a measure categorized from A to F, A being the top grade where other vehicles do not influence the driver, whereas F grade points out the 'jammed' or forced flow. The mathematical formula to calculate LOS depends of three factors i.e. speed, service flow rate and volume to capacity ratio (v/c). The least acceptable grade between A to F is D. The speed of the vehicle accounts for approximately 80 to 90%

of the total capacity. When measuring the LOS for intersection over a 15-minute analysis period, it is termed as the average stopped delay per vehicle.

2.3.5 Vehicle queuing

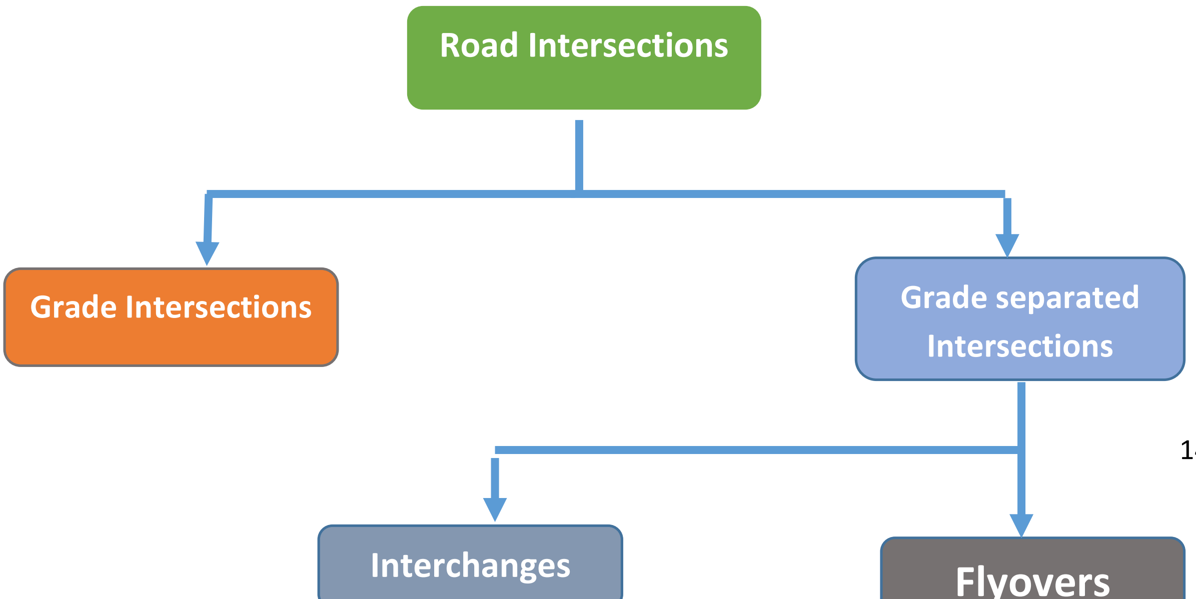
Vehicle Queuing is a study of traffic behavior and a significant measure of effectiveness which should be calculated while analyzing the signalized intersection usually where the demand exceeds available capacity. Vehicle queues estimates help in determining if the spillover will occur at upstream facilities (signalized intersections, un-signalized intersections and driveways etc.) or the storage amount required for the turn lanes. According to research, overrepresentation of rear-end collisions occur when there are extensive queues. During the expected design period, Vehicle queues for design purposes are typically estimated based on the 95th percentile queue.

The role of traffic engineer comes is to solve traffic problems on such intersections while optimizing the operation of the existing traffic system. The process starts with considering the problems which obstructs the traffic flow along the traffic facility; and it is necessary to increase the effectiveness of the traffic control factors so to minimize the traffic congestion. Therefore, traffic efficiency and performance are the key factors which should be increased while improving the different traffic elements. These traffic elements consist of TDM actions, parking control, geometric design elements and phase sequences.

2.4 Classification of Intersections

Intersections are classified depending upon the treatment of crossing conflicts as shown in fig 2.1 i.e.

- At Grade Intersection
- Grade Separated Intersection.



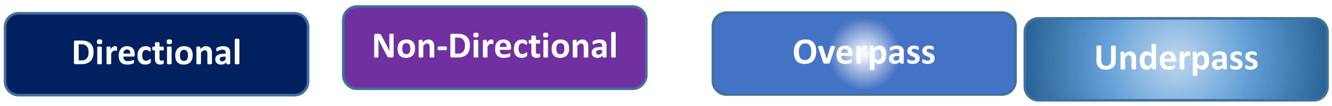


Figure 2.1 classifications of intersections

2.4.1 Grade separated intersections

Grade separated intersections or interchanges ensure the elimination of crossing conflicts that might occur at intersections by vertical separations of roadways in space.

The patterns of various turning ramps and roadways are interchanges. The basic design of interchange configuration is made in such a way to ensure economical traffic necessities of flow, right-of-way and direction of movements, type of controls, adjoining land use, physical requirements of topography and operation on the crossing facilities. Elimination of all grade crossing conflicts and accommodating other intersecting maneuvers by weaving, diverging and merging at low speed is the main objective of grade separated intersections. Some of the grade separated intersections are as follows:

2.4.1.1 Underpass

An underpass also known as tunnel is completely enclosed underground passageway except for the basic entry exit openings. Tunnels can either be for foot or rail or vehicular road traffic. Subway on the other hand is constructed beneath a road or railway for cyclists/pedestrians. Underpass and subways are built to assist the movement of pedestrians to cross railroad. An underpass is shown in fig 2.2.

Figure 2.2 Underpass

2.4.1.2 Overpass

An overpass or flyover is a structure similar to bridge which usually crosses over the railway or road line. Overpasses ensure that the traffic flow is unobstructed. If there are busy roads, pedestrian overpass allows the safe crossing for pedestrians. An overpass is shown in fig 2.3.

Figure 2.3 Overpass

2.4.1.3 Trumpet interchange

Trumpet interchange is a 3 leg interchange where one leg meets at an angle to the highway but does not cross it. At least one loop ramp is necessary to connect the traffic whether it is entering or leaving the terminating expressway. The farthest lanes are being used for the continuous highway. The interchanges are being used for toll roads and highways. It consists of only one bridge and is the most common practice of grade separating a three-way junction. A trumpet interchange is shown in fig 2.4.

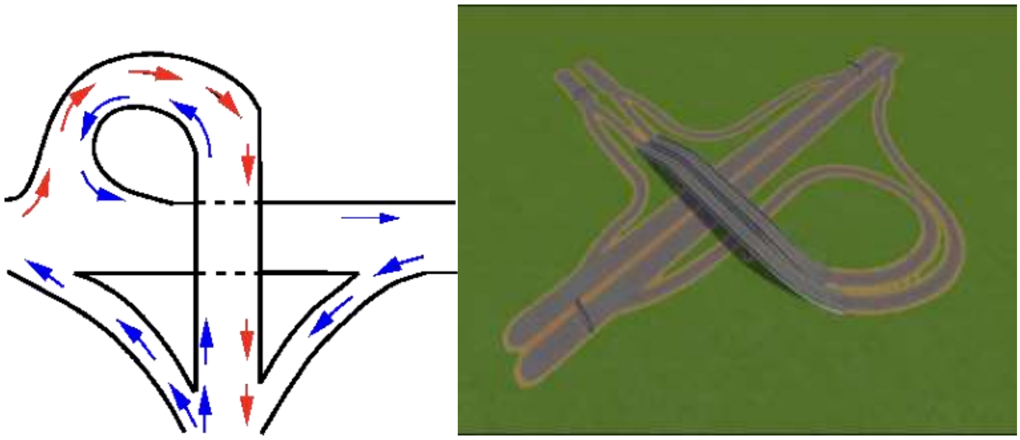


Figure 2.4 Trumpet Interchange

2.4.1.4 Diamond interchange

The diamond Interchange is a four leg grade separated intersection in urban areas where major and minor roads cross. The conflicts between crossing traffic and through traffic are eliminated by bridge structure. This intersection has four one way ramps which are essentially parallel to the major artery. By eliminating the conflict of traffic in opposite direction, left turn crossing movement conflicts are reduced. All the remaining left turn conflicts, diverging and merging maneuver conflicts take place at the terminal point of each ramp. The diamond interchange is very economical to construct and required a small area of land. There is less vehicle operating cost compared to other types of interchanges. A diamond interchange is shown in fig 2.5.

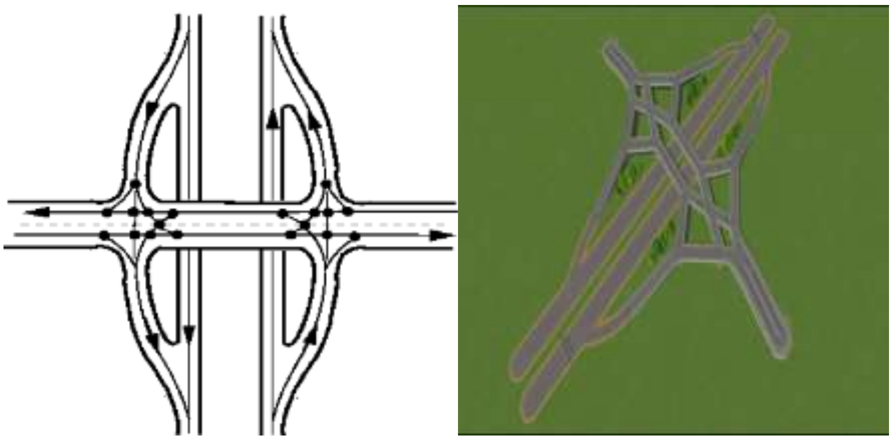


Figure 2.5 Diamond Interchange

2.4.1.5 Cloverleaf interchange

Cloverleaf is a four leg grade separated interchange mainly used in rural areas due to large area of land it requires. By the use of weaving stations, all crossing movement conflicts are completely eliminated by the full clover interchange. The weaving section is important parameter of cloverleaf design interchange. It substitutes a crossing conflict with a merging, followed at some distance farther by a diverging conflict. In between the entry and exit points, weaving section is being created near the structure. Sufficient capacity and length is required to be provided in order to ensure smooth diverging and merging operation. As only one bridge is required for the Cloverleaf design, it is easy to say that it is the economical form which allows the removal of all the crossing movements at grade. A cloverleaf interchange is shown in fig 2.6.

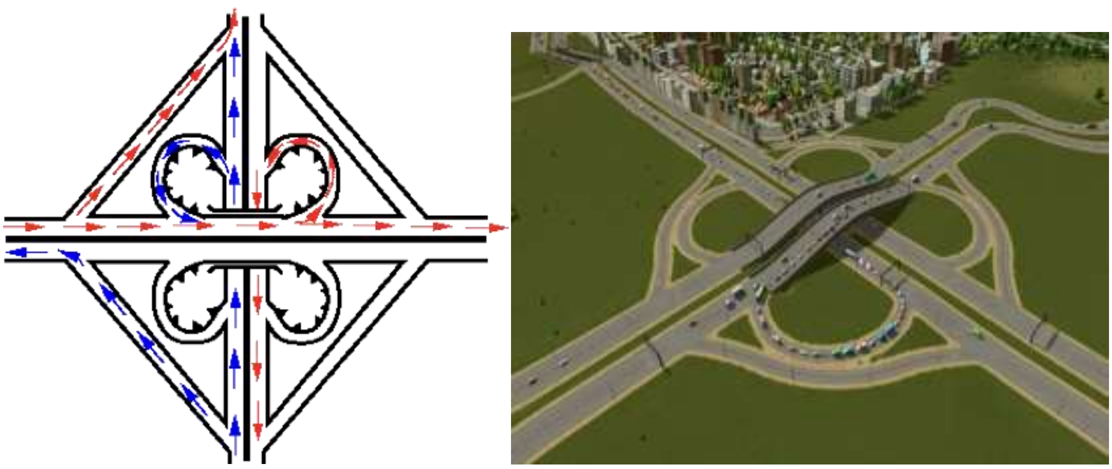


Figure 2.6 Cloverleaf interchange

2.4.1.6 Partial cloverleaf interchange

Partial Cloverleaf interchange is another form of cloverleaf configuration also known as Parclo. It basically combines the major elements of diamond interchange add one or more loops of cloverleaf in order to eliminate more critical turning conflicts. Parclo, nowadays is the most famous freeway-to-arterial interchange and considered as the state of the art. This interchange is built when crossing roads on the secondary road and will be safe in terms of hazard and time delay ensuring more deceleration and acceleration space. A partial cloverleaf interchange is shown in fig 2.7.

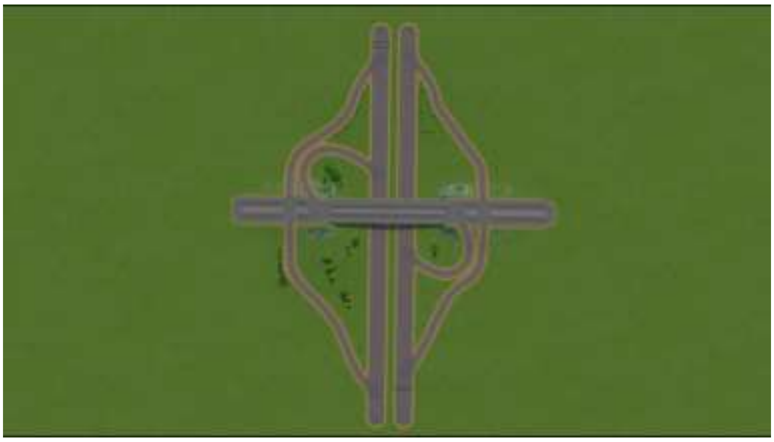


Figure 2.7 Partial cloverleaf interchange

2.5 Case Studies

2.5.1 Design and simulation analysis of at grade intersection channelization of city roads.

With the increasing number of vehicles and traffic, traffic jams and congestions are becoming a serious concern especially at the intersections. Channelization is a well-known and effective way of dealing with these increasing traffic jams. Channelization is the process of easing the traffic flow in the main traffic lanes by use of secondary roads. These secondary roads separate a certain flow of traffic from the main traffic lane.

Channelization is being carried out for a number of reasons. This includes its strong practicality as it reduces the distance between vehicles and pedestrians at the intersection resulting in increased traffic capacity at the intersection. Further, channelization is cost effective due to its small size and short construction period. Channelization makes the roads safer and also makes it appear more beautiful and organized. Trees and plants can be planted on the channelization islands which not only add to the scenic beauty but are also beneficial for the environment.

The conditions in which channelization is used in at grade intersections include heavy flow of traffic at the intersection. In addition, at grade intersection channelization is used when there is a large at grade area and space for channelization islands and expanding motorways. Intersections where there are a high number of vehicles turning towards left, are most suitable for at grade intersection channelization.

Channelization of traffic improves the traffic capacity of intersections and makes the traffic more efficient by getting rid of conflicting points between the passengers and vehicles pathways. This also helps in reducing the number of traffic accidents as the flow of traffic is more organized and less mixed. If all kind of vehicles and passengers are using the same road, there are more chances of traffic becoming disoriented and this might result in traffic accidents. When, through channelization, the non-power driven vehicles, the standard vehicles and passengers are using separate pathways and do not have conflicting pathways, the likelihood of occurrence of traffic accidents reduces.

A traffic survey is used to design the intersection channelization design. This survey analyses the current traffic flow at the intersection and potential problems. This survey is used to analyze the traffic volume at the intersection and hence, the peak traffic hour at the intersection is obtained. The already existent traffic problems at the intersection are analyzed. For the particular case discussed in the paper in which the intersection is a cross intersection, the problems include the presence of few traffic lanes and hence, heavy traffic pressure. Another problem seriously hampering the traffic flow efficiency is the long queues at the intersection. Unreasonable signal control was another major factor causing problems for traffic flow at the intersection. Another major problem causing traffic bottlenecks and congestion was the incorrect distribution of lane functions.

Based on the above problems, channelization scheme design is formulated to improve traffic flow and increase efficiency at the intersections for the particular case. The main features of a channelization scheme design include appropriately allocating the lane functions. This also includes arranging a special phase for left turn so traffic doesn’t conflict. For the vehicles that turn right, the design includes adding channelization islands. A turn waiting zone should also be included for the left turning vehicles. Further, the stop lane for vehicles and non-power vehicles should also be moved forward.

The channelization scheme for the particular case in paper was designed using VISSIM simulation software. This evaluated the specific design keeping in view the queue length, the delay and service level of vehicles both before the channelization scheme design and after its implementation. A comparison between both is then made. From the results for this case it can be deduced that the length of queue significantly decreased after the implementation of channelization scheme design at the intersection. For example, the average queue length for East direction reduced from 8.47m to 7.125m which is a considerable difference. Keeping this in view, through lane was added and the stop lane was also moved forward. The comparison also showed the delay time to reduce from 21.1s to 20.6s. This was due to the improvement and optimization of lanes and their traffic capacity. Although the level service after channelization was still C, but overall traffic flow and capacity improved at the intersection. Hence, the channelization plan was practical and feasible for this particular case. Table 2.1 gives a comparison before and after channelization.

Table 2.1 Perimeters before and after channelization

Directions	Status Quo			Post-channelization		
	Average queue length / m	Average delay / s	Service level	Average queue length / m	Average delay / s	Service level
East	8,47	12,08	B	7,125	19,16	B
South	13,07	29,28	C	8,8	21,97	C
West	23,2	14,50	B	9,65	20,4	C
North	23,7	30,13	C	9,125	20,95	C
Intersection	17,1	21,1	C	8,7	20,6	C

2.5.2 A study on feasible traffic operation alternatives at signalized intersection in Dhaka city.

Due to unreasonable signal control, illegal car parking, traffic influx from side approaches and oversaturation, traffic congestion in Dhaka is emerging as a major problem. This issue is specifically grave at the intersections where the existing traditional traffic congestion mitigation techniques have reached their maximum potential and are now failing. One of the most important intersections, the Science-Laboratory-Elephant Road intersection and its traffic congestion problems are discussed in this paper. Continuous flow interchange design is discussed in this paper as a novel traffic congestion mitigation strategy.

In order to resolve the issue of traffic congestion, various researchers have come up with different solutions. This includes signal control, main roads management and prohibiting turns at certain intersections. Lane optimization has also been suggested as another way to reduce traffic jams. Introducing one-ways in place of two way streets not only increases travel speed and chances of collision and accidents but is also believed to reduce hours of travel and increase a vehicle's miles of travel. VISSIM has been used extensively to compare various design strategies of traffic improvement in order to develop the design model for traffic improvement on Science Laboratory-Elephant Road intersection traffic volume data for each side approach to the intersection was gathered. Data regarding the volume of vehicles taking a turn and vehicles passing through was also collected. The peak traffic hours were then identified. Morning peak time was same for all the side approaches to the intersection so the morning peak time was used for the rest of the analysis. Morning data was collected for all the four side approaches of the intersection, three traffic signals and one U-turn traffic. VISSIM was then used to model the existing road conditions and traffic data. Two other alternatives, improving signal control and timing and building an overpass, were then suggested and modeled on VISSIM and compared. From the evaluation of models formulated from VISSIM, the best option was recommended further.

Average speed, average delay and queue length were the major parameters on which the two alternatives were compared with existing road condition. Table 2.2 given below depicts the result of the VISSIM model.

Table 2.2 result of the VISSIM model

	Average Speed (m/hr)	% Increase of average speed	Delay (sec)	% Decrease of delay	Average queue length (ft)	% Decrease of queue length
Scenario 1	10.91	N/A	33.89	N/A	268	N/A
Scenario 2	12.8	17.32%	12.94	61.82%	197.5	26.31%
Scenario 3	38.25	250.60%	0	100.00%	19	92.91%

The bar graphs below (taken from the paper), compare the average speed, the average delay and average queue length obtained from the VISSIM model.

Figure 2.8 comparative average speed

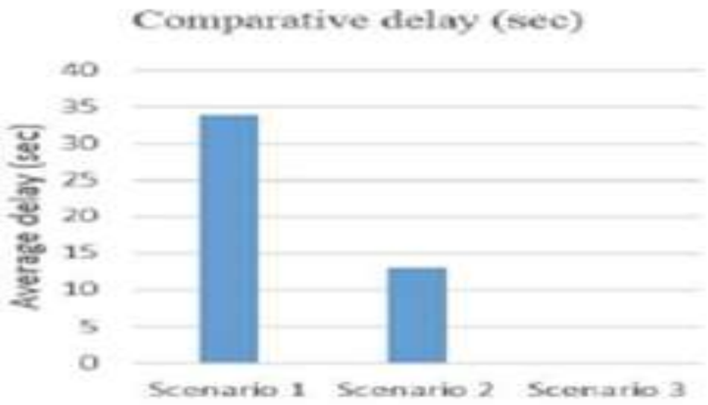


Figure 2.9 Comparative Delay

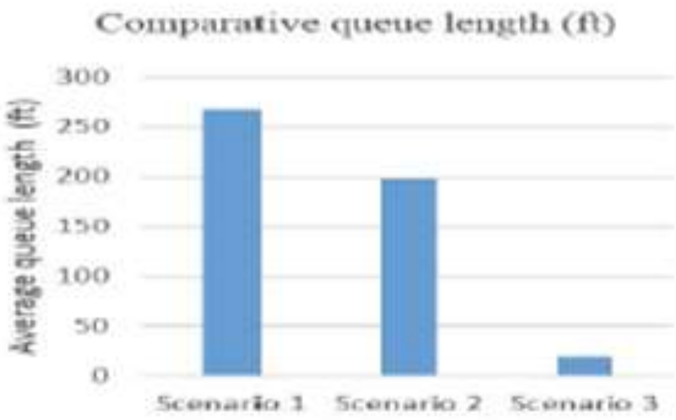


Figure 2.10 Comparative Queue Length

In figure 2.8, 2.9, and 2.10 depicts that the scenario 2 is where the traffic signal timing was made better and strict control on traffic signals was made whereas scenario 3 is where the overpass was constructed. The results show a much greater average speed, a much lesser average delay and a much smaller queue length for scenario 3. As per this study and the results of the model, scenario 3 i.e. building an overpass is the most suitable method to control traffic congestion at the intersection. It shows drastically improved traffic condition at the intersection by reducing delay by 100%, increasing average speed by 250.6% and reducing queue length by 92.91% from the current scenario.

Hence, building an overpass is the best solution for such a huge traffic influx from all side approaches of the intersection.

Chapter 3

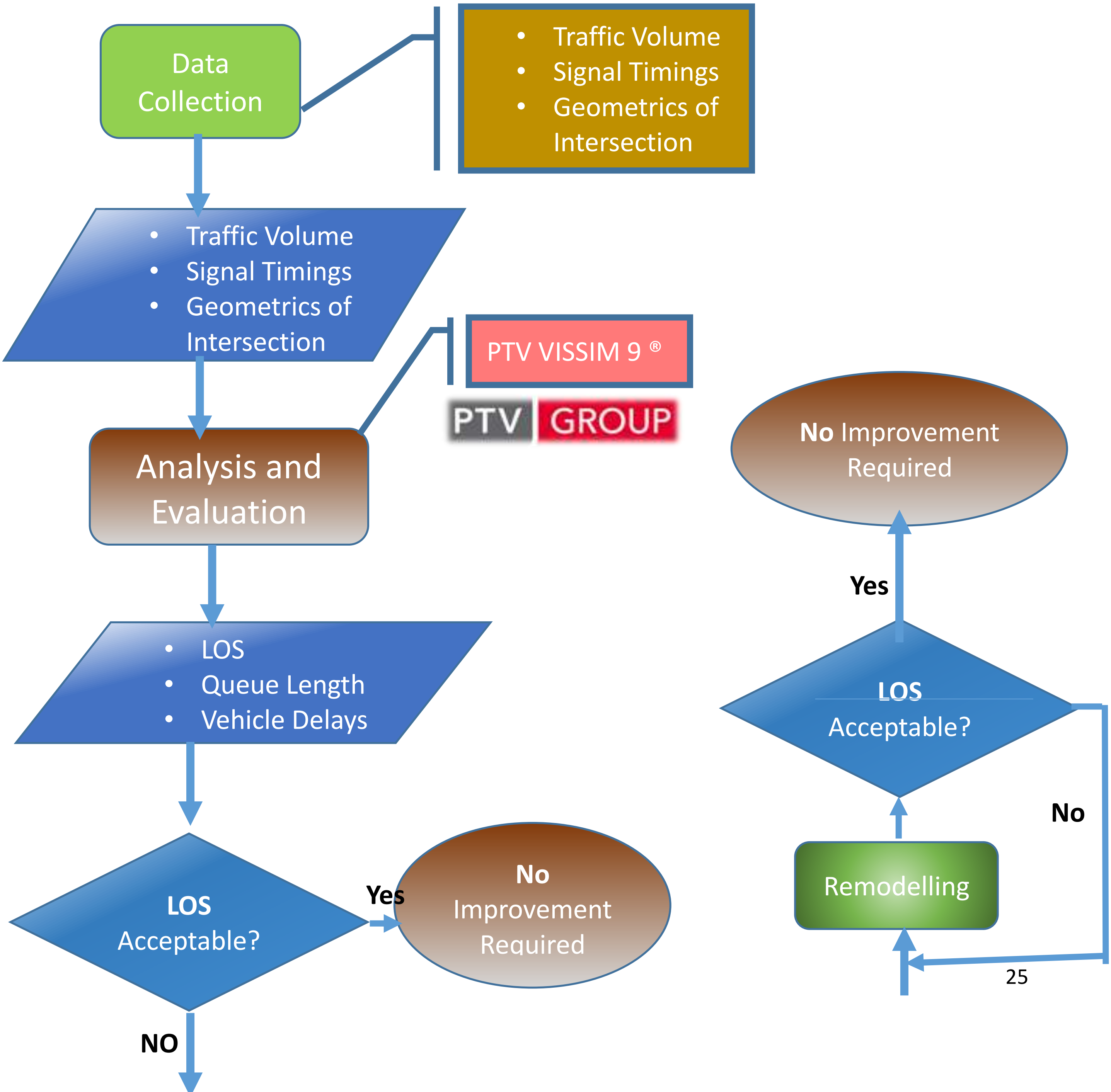
METHODOLOGY

3.1 Project Methodology

The systematic and theoretical analysis of method applied to achieve the mentioned objectives. “Its purpose is to explain and justify the use of particular methods” (Wellington, 2000).

Data collection was done at site by doing a traffic survey at 12th avenue. Traffic volumes, signal timings and current geometric conditions were fed into VISSIM and its processing was done using VISSIM software, which evaluated the Level of service, queue length and vehicles delays. Then proposed Improvements were made which included the minor interventions, Minor interventions increased the level of service but it was not up to standard. So to make acceptable level of service infrastructure improvements were made which included remodeling of the intersection and this process was repeated until the Level of service was Acceptable.

“Transportation is the center of the world! It is the glue of our daily lives. When it goes well, we don't see it. When it goes wrong, it negatively colors our day, makes us feel angry and impotent, and curtails our possibilities. “(Robin Chase)


Data Collection
Traffic Volume
Signal Timings
Geometrics of Intersection
Traffic Volume
Signal Timings
Geometrics of Intersection
PTV VISSIM 9 ®
PTV GROUP
Analysis and Evaluation
LOS
Queue Length
Vehicle Delays
LOS Acceptable?
Yes
No Improvement Required
NO
No Improvement Required
Yes
LOS Acceptable?
No
Remodelling

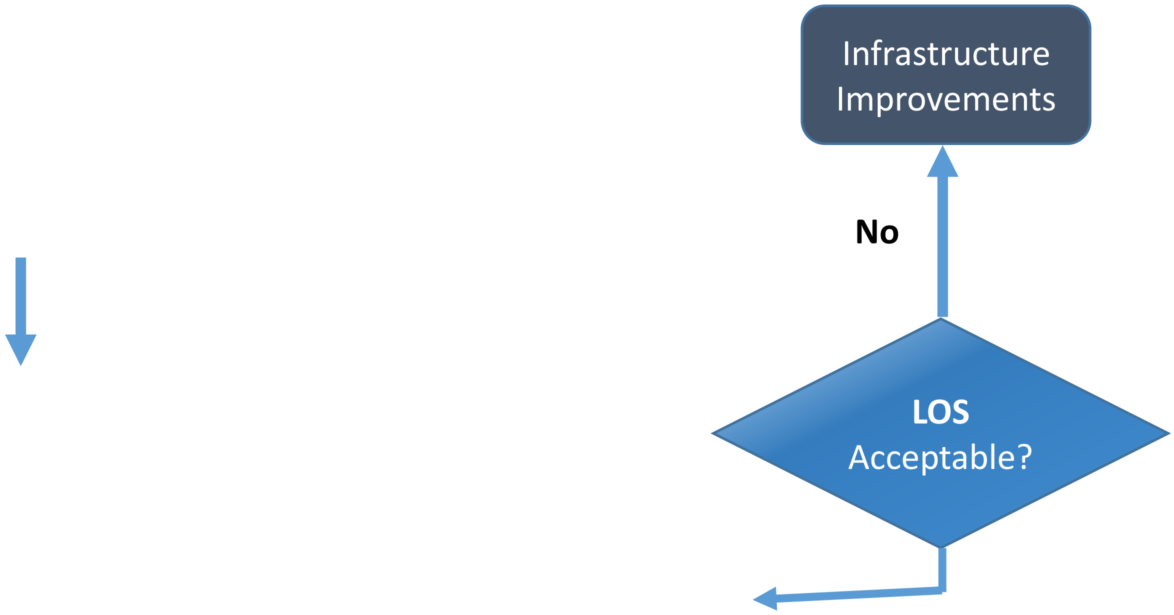


Figure 3.1 Flowchart of Methodology

3.2 General

To accommodate [illegible] re conducting intersection capaci [illegible] c prevailing on site.

3.3 Planning for Traffic Surveys

A layout of plan was made consisting steps being followed to conduct the traffic survey at calculate LOS surveys were carried out at site detailed traffic survey was done. It included several site visits. Survey was carried out at 12th avenue on Monday and Friday on peak hours, morning and evening hours. Traffic projections were calculated for next 10 years with the maximum traffic growth factor in twin cities. The aim was to reduce queue and traffic delay by proposing a new intersection design which was good enough 12th avenue. All aspects of traffic survey such as schedule, methodology and data collection format was taken into account and various site visits were made before the survey of the intersection. An original simulation was made of the existing situation for better evaluation of the proposed interchange.

3.4 Traffic Count Survey:

To calculate the performance of the existing road network of 12th avenue tools which were used are traffic counts, turning volumes and geometric conditions. These were collected on all 4 legs of the intersection. The data was collected manually using tally method on morning and evening peak hours in morning data was collected from 8 am – 10 am and in evening it was collected from 3pm – 8 pm. It was found that maximum traffic count occurred during the peak hours in evening time. A 15-min interval was used to make traffic count and the highest count in the recorded was used for further analysis.

The vehicles were divided into two categories:

- Small vehicles
  - Vehicles moving on 3-4 wheels
- Large vehicles
  - Vehicles having more than 4 wheels

3.5 Geometric Conditions

On site geometric data which was collected is as follows:

1. No of Lanes(L)
2. Lane width(W)ft
3. Area type(Rural or Urban)
4. Grade(G) %
5. Existence of exclusive LT or RT

This data was collected and proposed intersection design was made according to these parameters.

3.6 Signalization Conditions of 12th Avenue

The on-site signalized parameters measured are:

- Cycle Length (c) s
- Green time (G) s
- Yellow + all red + Clearance interval
- Pre-timed operation

3.7 Analysis of Traffic Conditions

The above data was evaluated to determine the capacity of the 12th avenue

- Peak hour Volumes using excel program
- Peak hour factor using excel program
- Saturation flow rate using highway capacity manual method

3.8 Determination of Level of Service (LOS)

The above parameters were fed into VISSIM 9 software to calculate the level of service of the existing condition. After making the existing intersection design in VISSIM 9 data was put in and analysis was carried out by simulation and the LOS was determined.

3.9 Proposed Design Alternatives

After the analysis of existing design of 12th avenue the level of service was unacceptable. Some proposed designs were made which would improve the current Level of Service and for the future. Optimized signal timings was made for fast and smooth flow of traffic.

A **Multi grade** interchange was proposed but it could be done in two ways:

1. Providing an Underpass for Kashmir Highway
2. Providing an Overpass for Kashmir Highway

3.10 Simulation of Traffic Progression in Proposed Design

The software VISSIM 9 was used to make simulation of proposed design of the traffic intersection, Level of Service was analyzed and made sure it was up to the AASHTO standards. The results of the simulations such as queue length and time delay determined the LOS.

Chapter 4

INTRODUCTION TO VISSIM

4.1 General

PTV VISSIM is a traffic Simulation software developed by Planung Transport Verkehr in Germany. PTV VISSIM was first developed in 1992 and now leading in traffic simulation softwares. The scope of application of the software ranges from solving traffic engineering problems to 3D visualization for the illustration of general public.

PTV VISSIM uses traffic data as an input and calculate different parameters using the data. These perimeters include vehicle delays (seconds), queue lengths (meters), level of service (LOS) etc. These perimeters are used to analyze traffic stream conditions at any intersection. Several other perimeters can also be calculated using VISSIM, these include environmental factors such as emission of CO, NO and other gases and also economic factors i.e. Fuel Consumption.

4.2 Getting Started VISSIM

4.2.1 General settings

1) Go to **edit > User Preferences > Network Editor.**

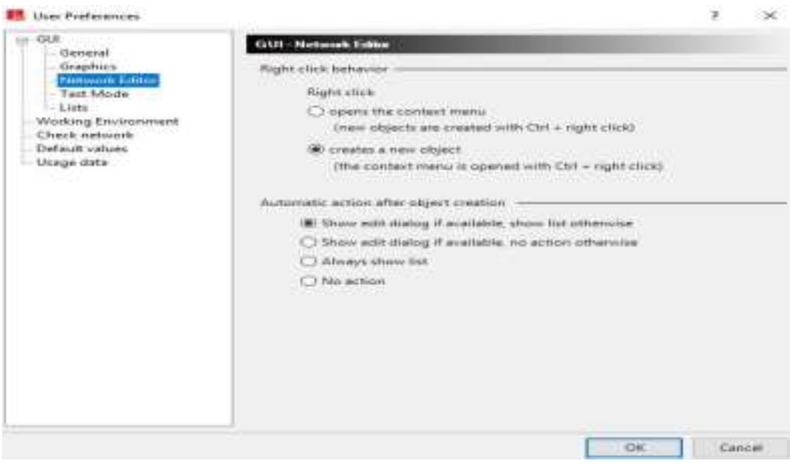


Figure 4.1 user preferences

2) Go to Base Data in **menu bar > Network Settings >** check Right hand Traffic and adjust attribute values if necessary.

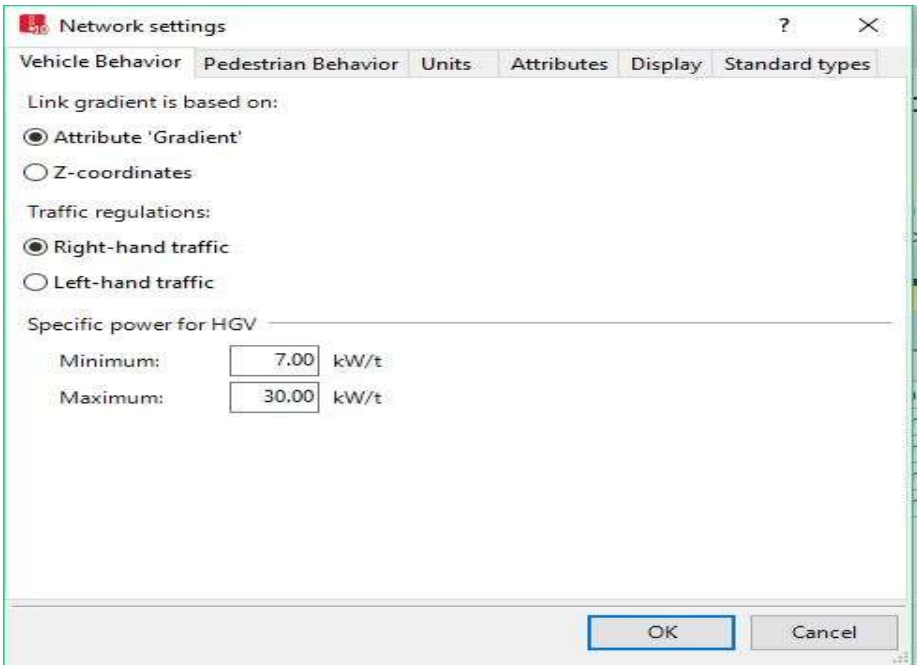


Figure 4.2 Network settings

4.2.2 Creating a network

1) Adding new **Background Image**

Select **background image** in network objects menu

Right click anywhere on the network editor and select the desired picture in pop up window and click open.

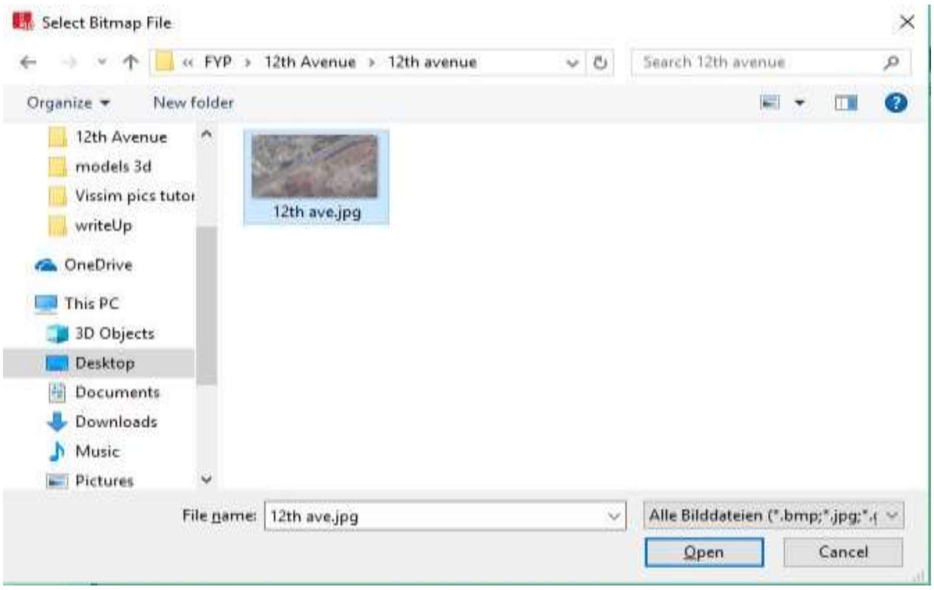


Figure 4.3 Adding Background Image

2) Adjusting scale of **Background Image**

Ctrl + Right click on the picture and select '**set scale'**

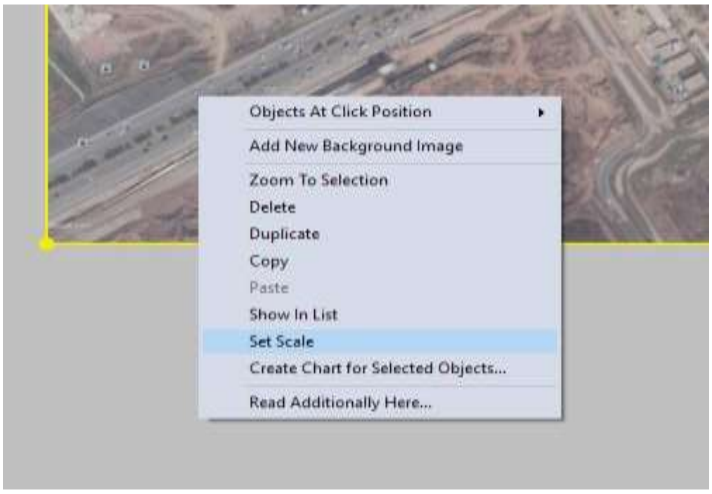


Figure 4.4 Adjusting Scale

3) Adding a link

Select link in the **Network Objects** menu

Click and hold right click > drag > release to create a link

A pop up window will appear, select desired options and click OK.

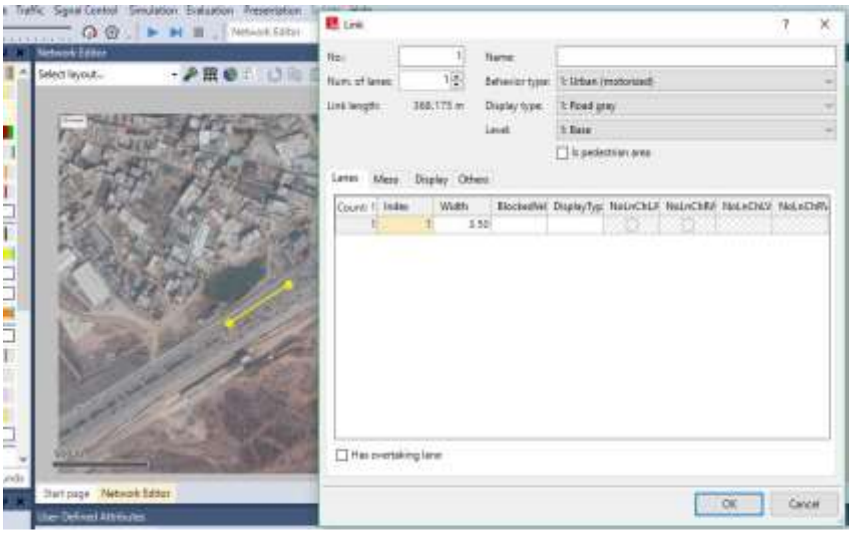


Figure 4.5 adding a link

4) Adding a **connector**

Connector can be added between two links.

Right click and drag from end of first link to the start of second.

A pop up window will appear, click okay after adjusting different attributes and click ‘OK’.

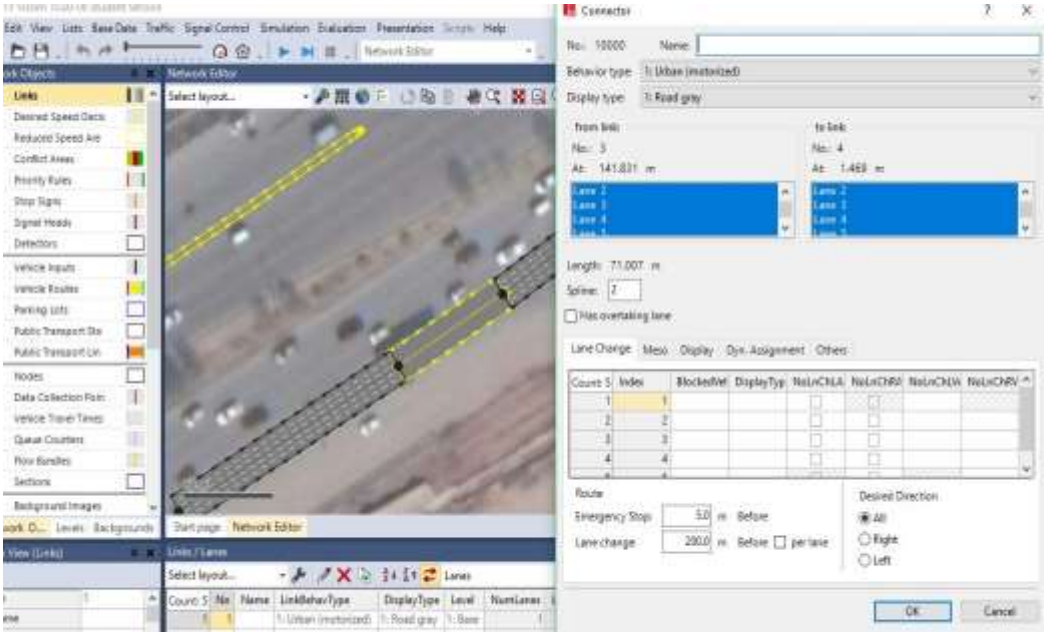


Figure 4.6 adding a connector

5) Creating a Circular Link

Ctrl + Right click anywhere on the network editor while ‘link’ is selected in **network objects** menu and select add circular link.

A pop up window will appear. Click ‘OK’ after changing attributes.

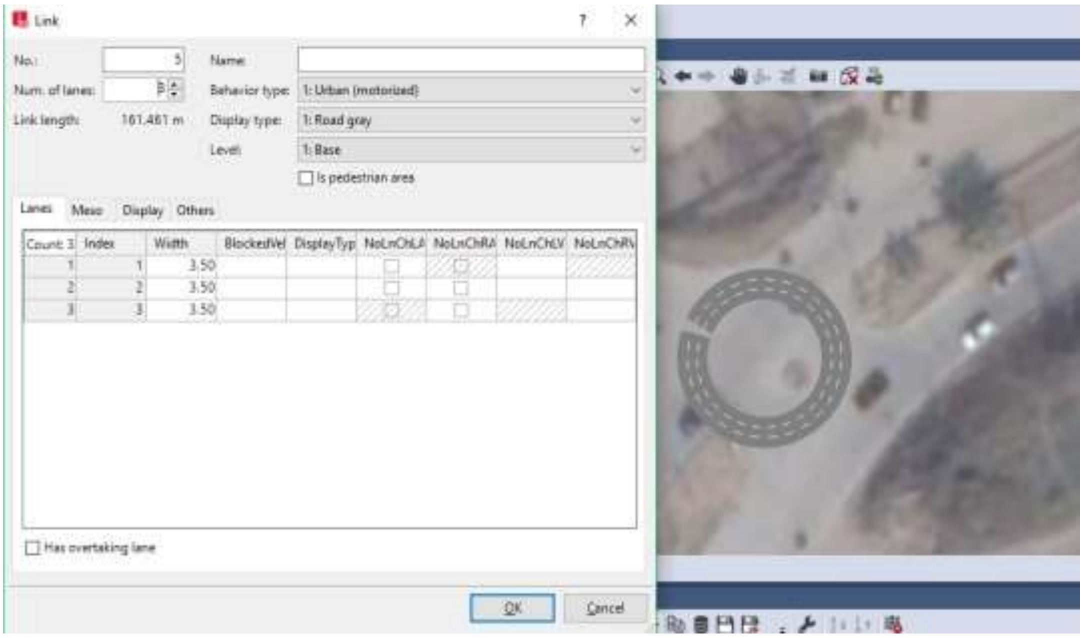


Figure 4.7 Creating a circular link

4.2.3 Adding vehicles

1) Vehicle Compositions

Go to Traffic > Vehicle Compositions.

Default vehicle composition is already added. Other vehicle compositions may also be added by clicking on '+' sign in the bottom window.

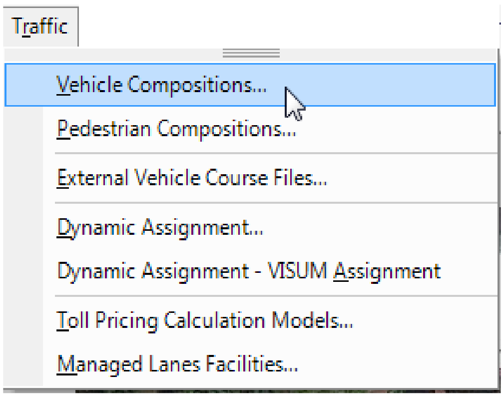


Figure 4.8 Vehicle Compositions

2) Vehicle Input

Number of vehicles entering a network through a link.

Select **Vehicle input** in network objects menu.

Right click on the link you want input from.

Change attributes in the bottom window.

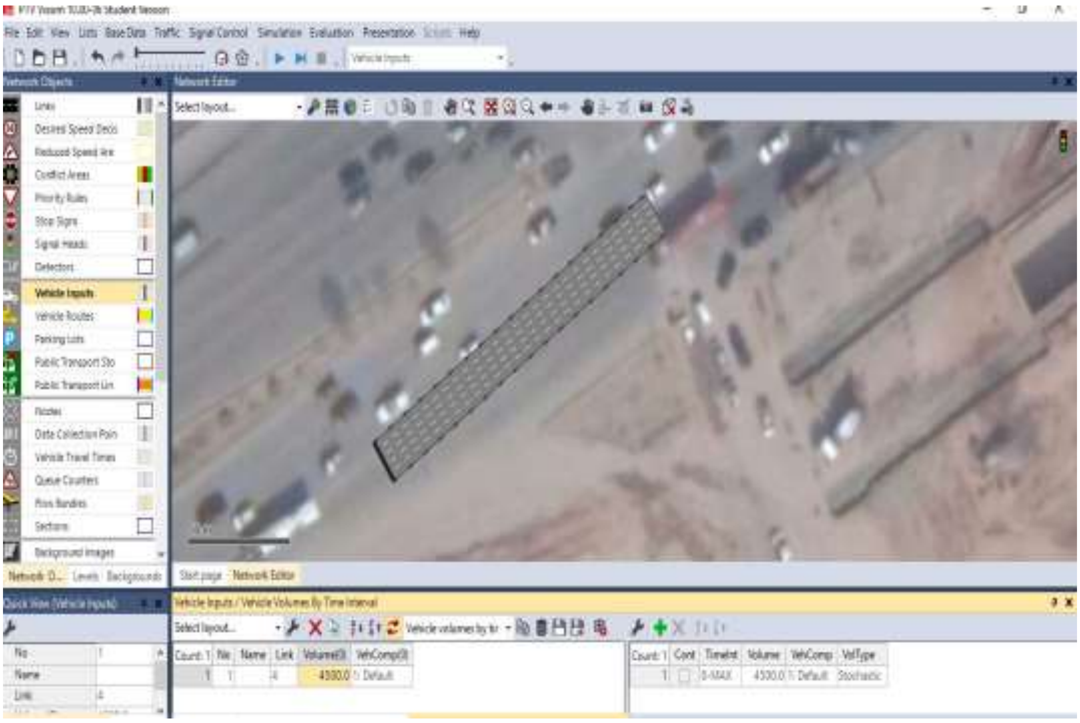


Figure 4.9 vehicle input

3) **Vehicle routes**

Add **vehicle routes** by selecting **vehicle routes** in network objects menu:

Right click on the link from where vehicle take routing decision and add different routes. Pink line indicates start and blue line indicates end of route.

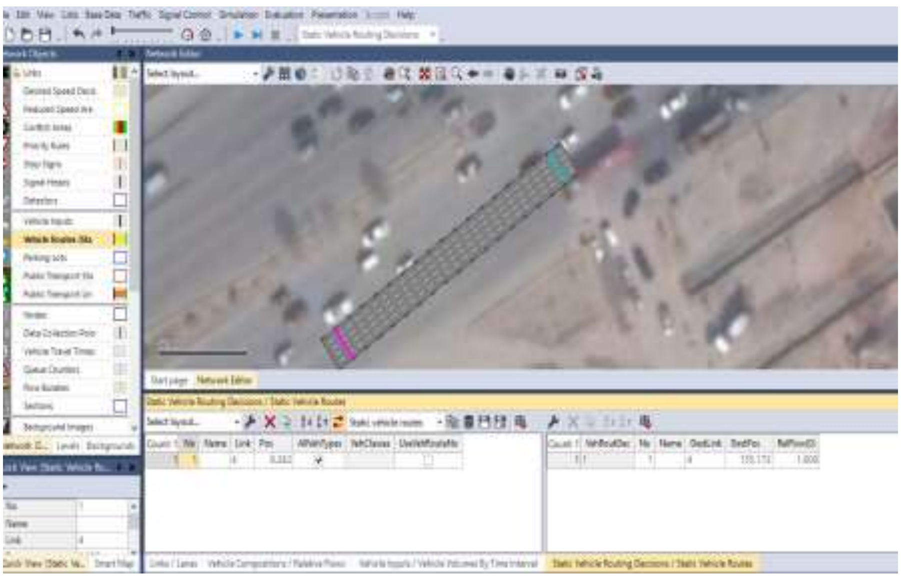


Figure 4.10 vehicle routes

4.2.4 Adding signal controllers

1) Create **Signal Control**

Go to signal Control > signal controllers in Menu bar.

Click on '+' sign to add signal control.

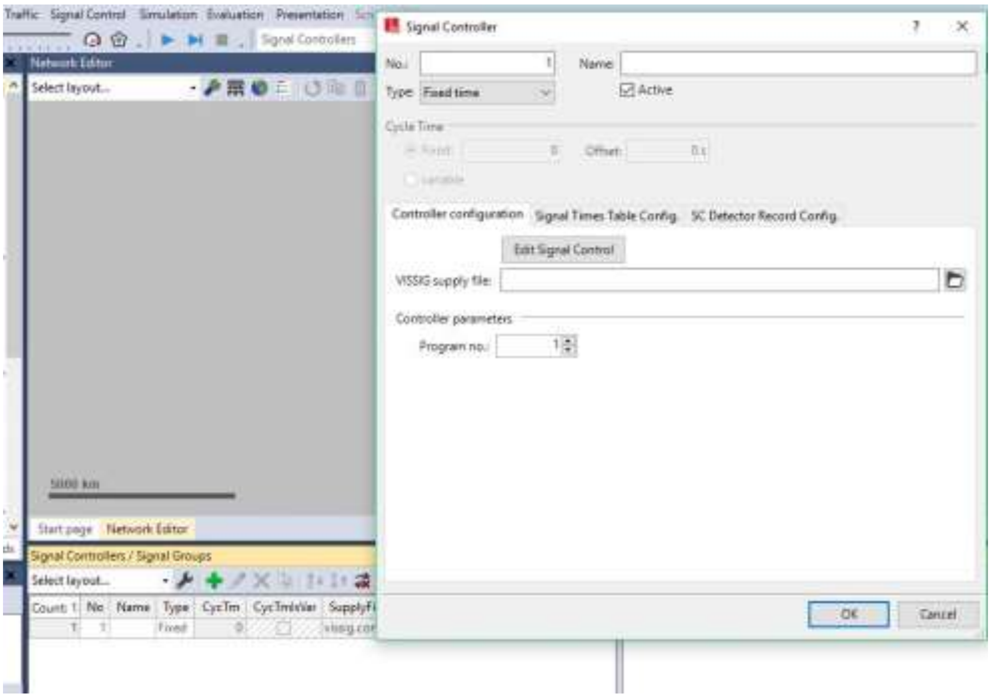


Figure 4.11 Signal Control

2) Edit signal control

Click on 'edit signal control'.

Add **signal groups**, **inter-green matrix** and **signal program**.

Click on save icon and then click 'OK'.

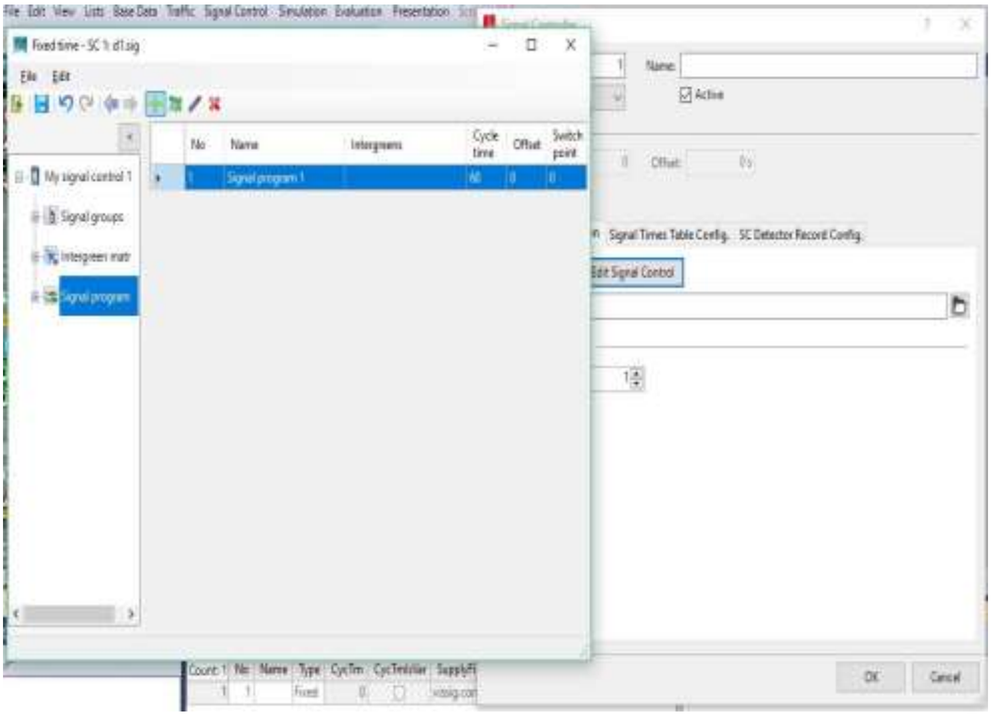


Figure 4.12 Edit Signal Control

3) Adding Signal heads

Select **signal heads** in the **Network objects** menu.

Click on the link where you want to place the signal control.

A pop up window will appear. Change different attributes as desired and click ‘OK’.

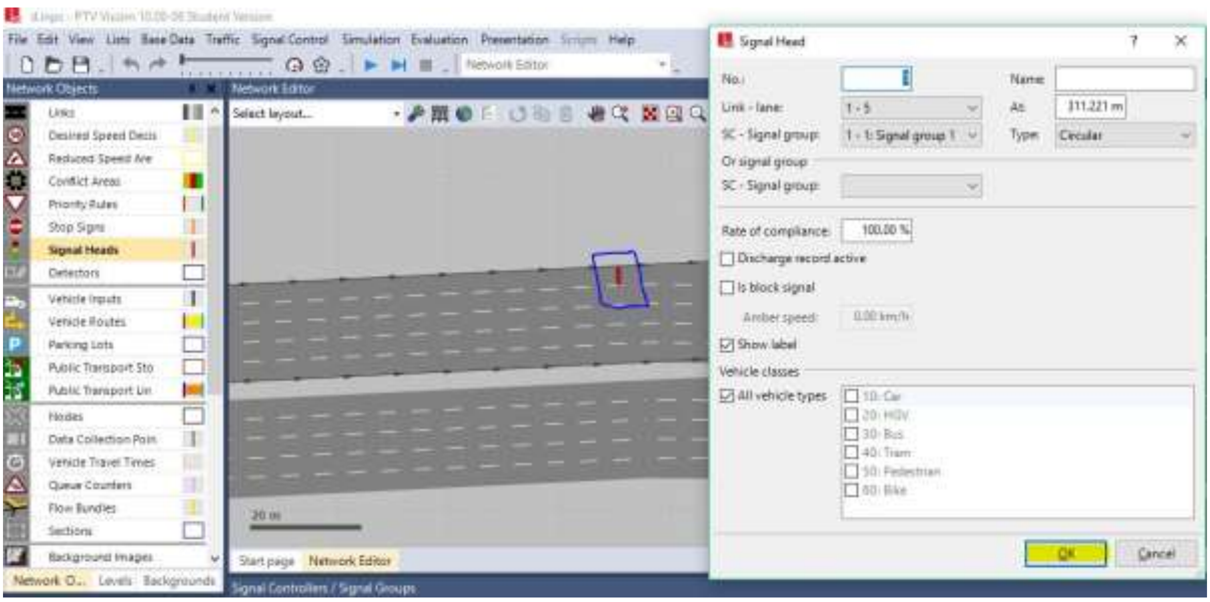


Figure 4.13 Add signal heads

4.2.5 Simulation

1) Simulation Perimeters

Go to simulation > Perimeters

Adjust perimeters as desired.

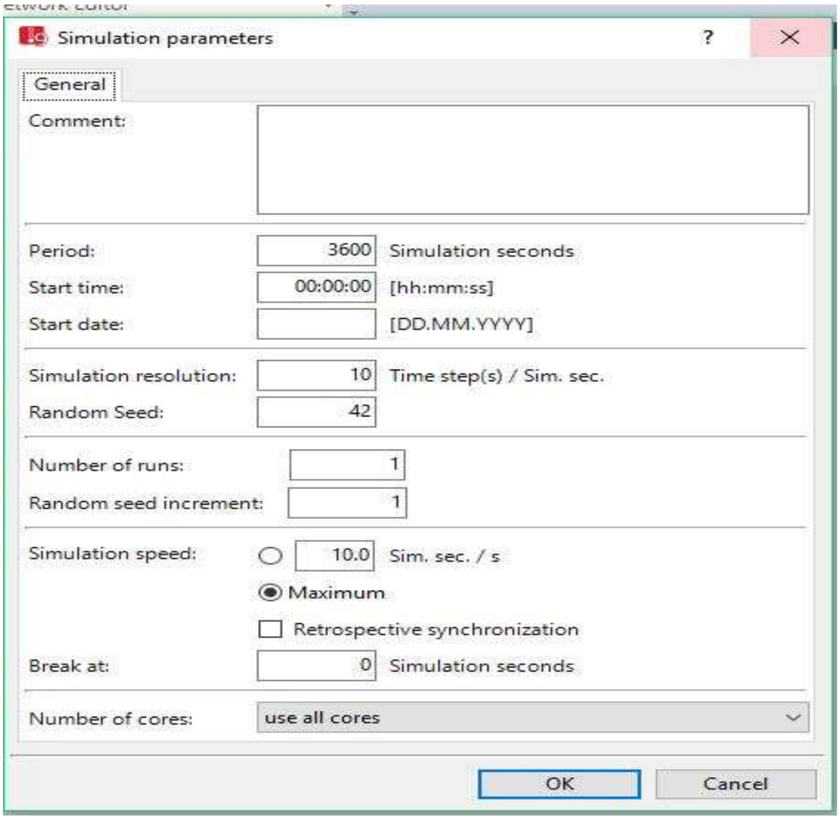


Figure 4.13 Simulation Perimeters

2) Running Simulation

Use  to run the simulation, use  to pause and play only one step at a time. Use  to stop the simulation. These all buttons can be find in the simulation bar.

3) Simulation speed

Simulation speed can be adjusted using simulation speed controller under simulation menu bar.

4.2.6 Obtaining results

1) Adding node

Select **Nodes** in the **Network Object** menu.

Select an area which you want analyze.

(Note: Node only analyses the traffic inside the node area)

A pop up window appears. Give node a name and click 'OK'.

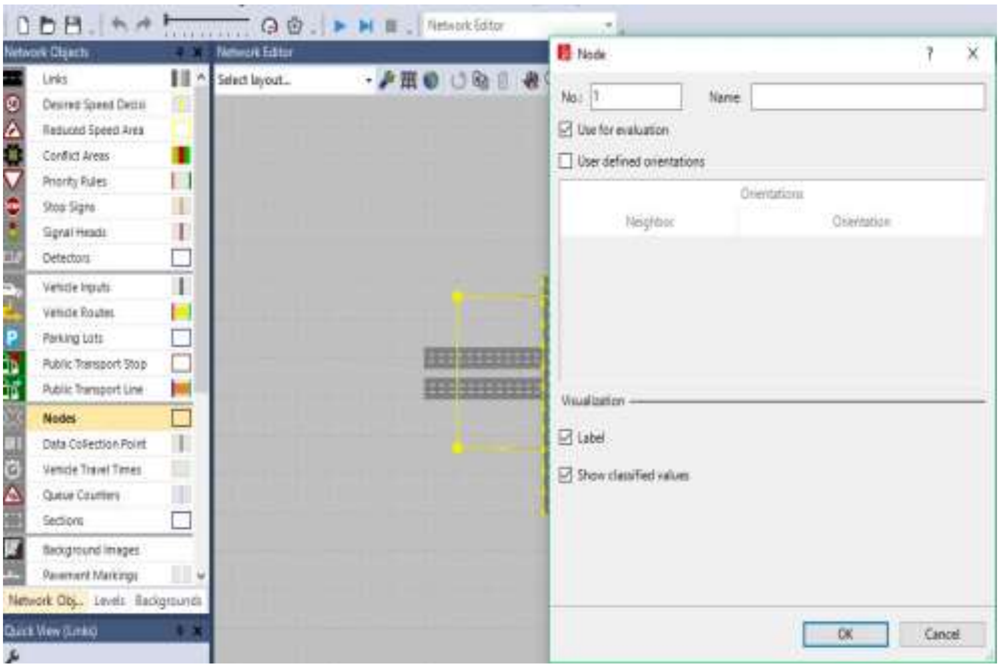


Figure 4.14 obtaining results

2) Adding Queue Counters.

Select **Queue counter** in **Network objects** menu.

Click where you want to add queue counter.

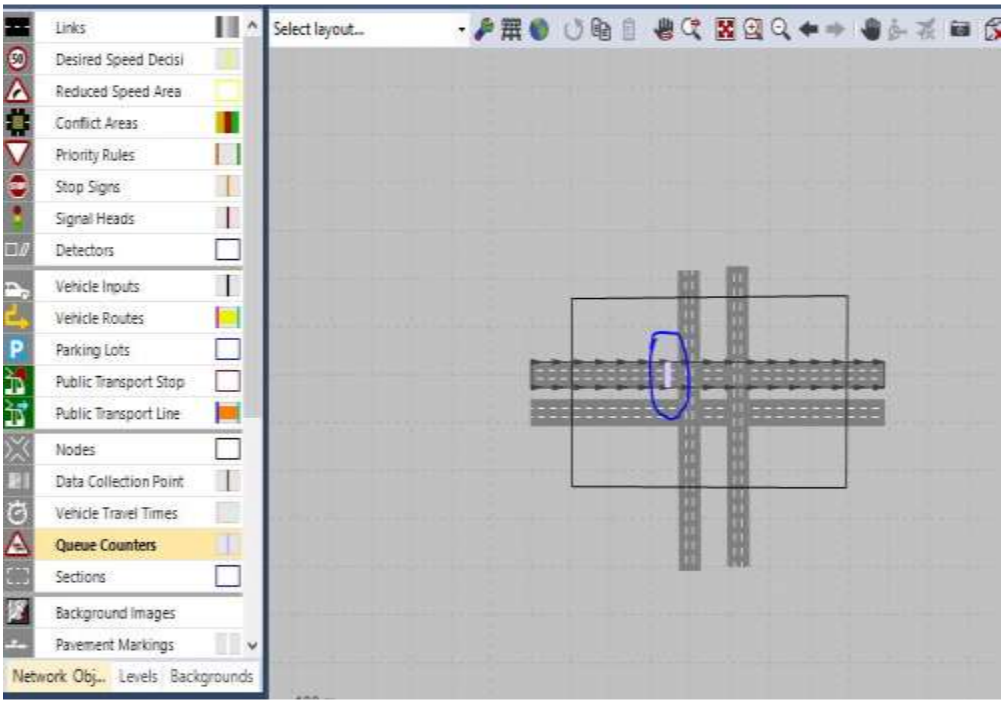


Figure 4.15 Queue Counters

3) Turning evaluation 'ON'

Go to Evaluation > Configuration in menu bar.

Under Collect Data column check 'Nodes' and 'Queue Counters'.

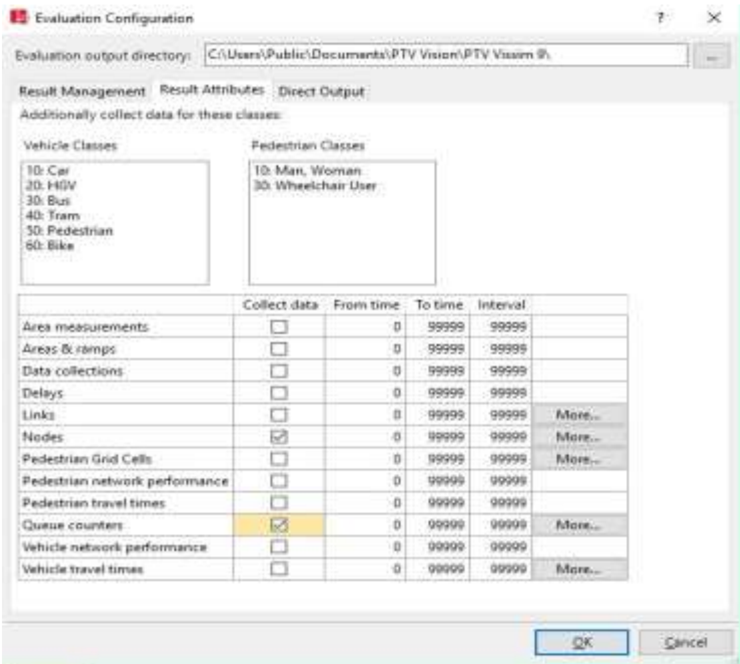


Figure 4.16 Evaluation Settings

4) Writing Results to file

Collect **travel time** and **delay output** data.

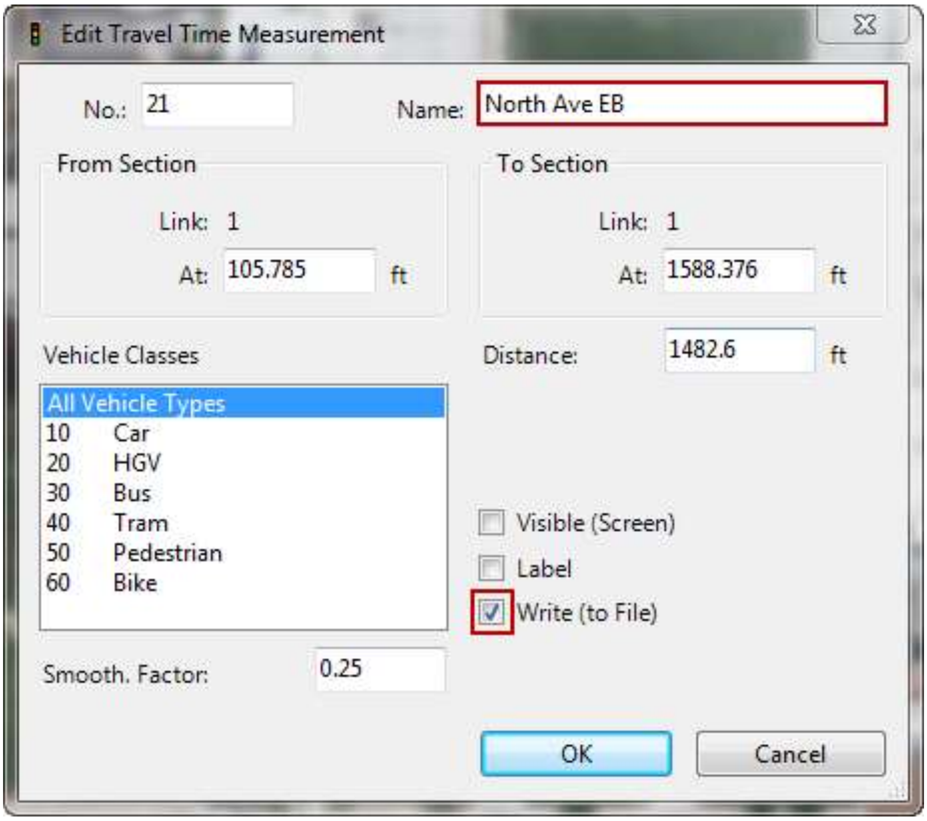


Figure 4.17 Results to file

Chapter 5

RESULTS AND ANALYSIS

5.1 Introduction

This section includes the existing Situation of 12th Avenue Interchange, Level of service provided and max delays encountered by the vehicles in Peak hour timings. In order to work efficiently and purposefully, EXCEL and VISSIM softwares were used to evaluate the data acquired through field surveys of traffic volumes, geometrics of road and turning Volumes.

5.2 Traffic Volume Counts

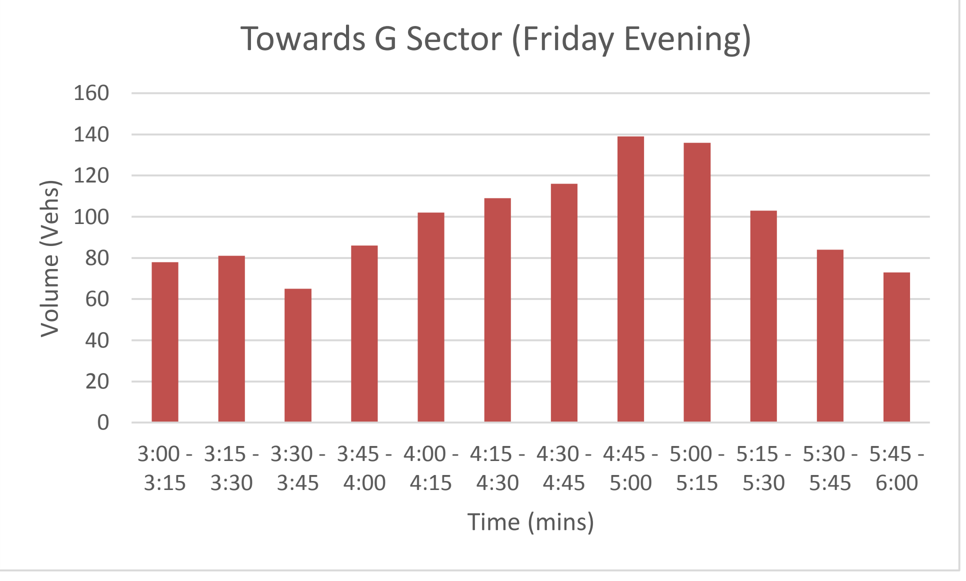
Traffic volume counts at the intersection were collected using JAMMAR counters. CDA was also contacted but they had no data available. This data was collected on Tuesdays and Friday from 07:00 AM to 08:00 PM. This data was then exported to excel files.

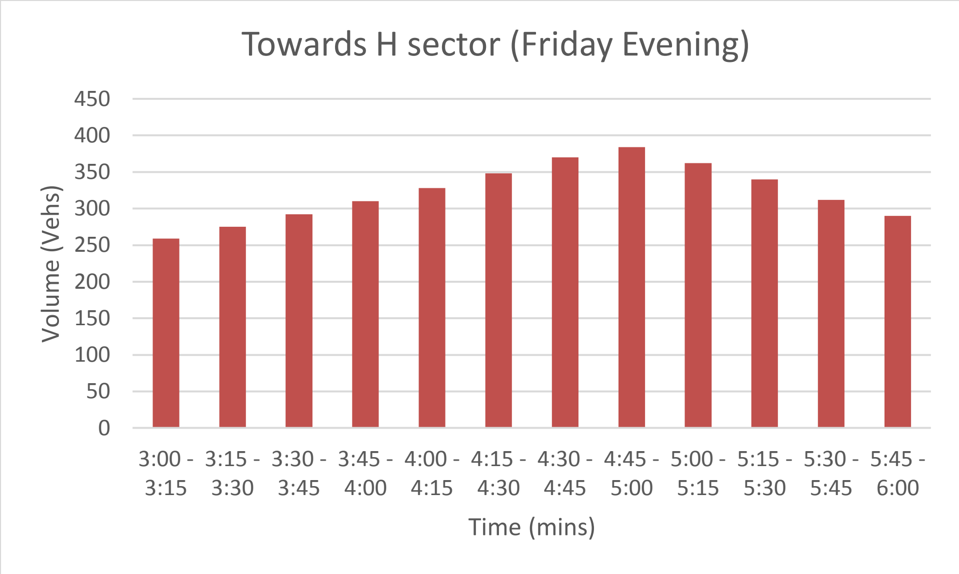
5.3 Peak Hour Volumes

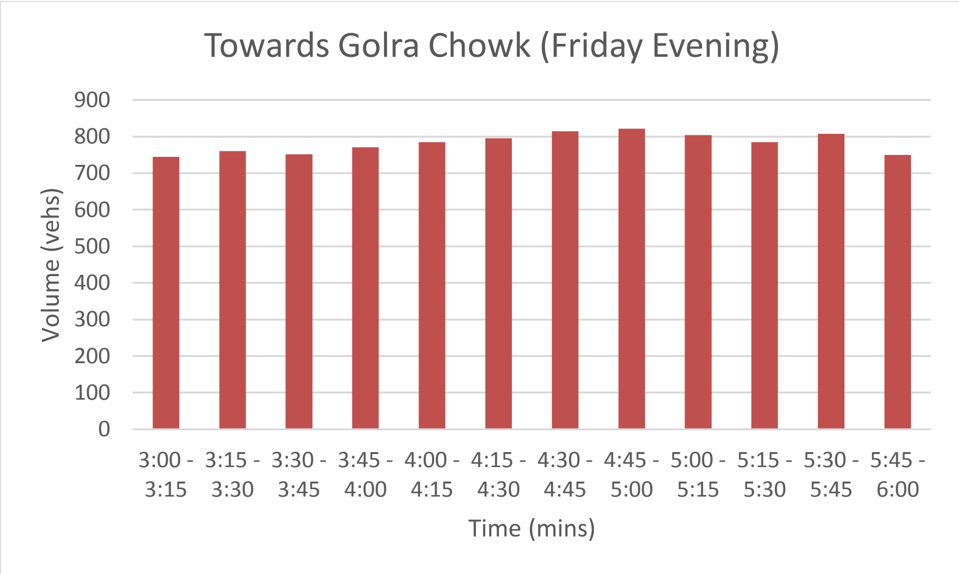
Peak Hour volumes as expected were from 05:00 pm to 06:00 pm on Tuesdays and 04:00 pm to 05:00 on Fridays.

Bar chart shows the data collected and organized in Excel.

a) Data for Friday evening is as shown in figure 5.1 below:







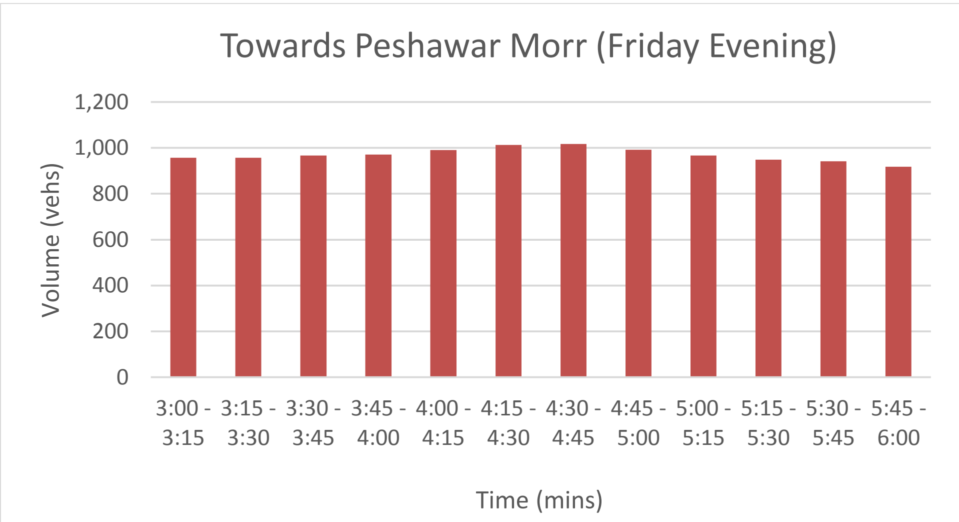
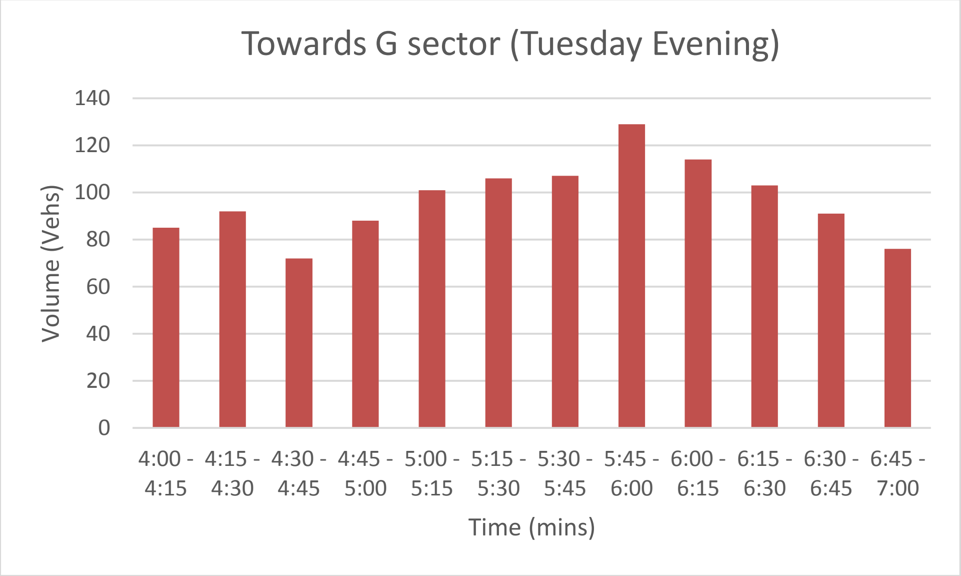
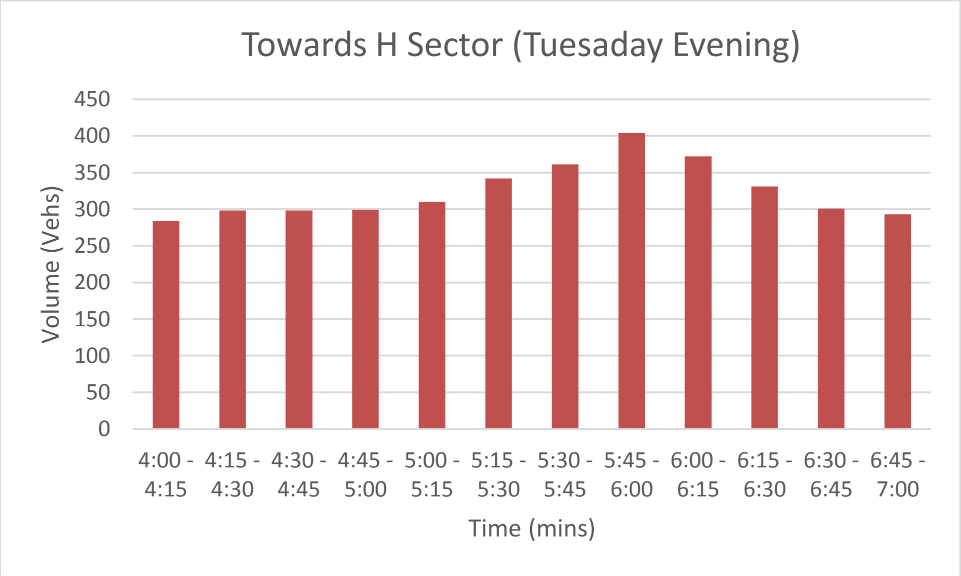


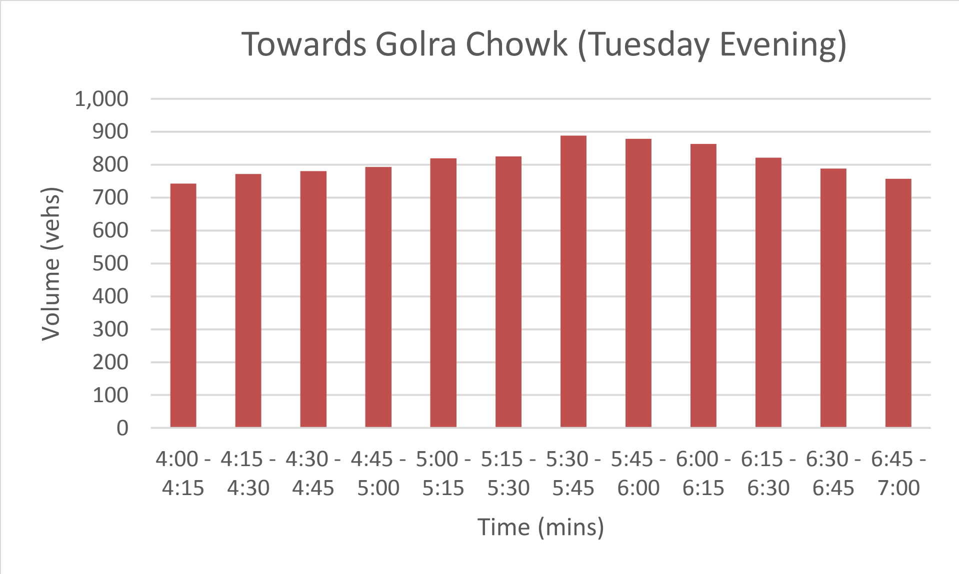
Figure 5.1 traffic counts of Friday evening

Peak hour traffic for Friday evening was in 04:15-05:15 PM. Traffic counts observed during that period were 9187 vehicles entering the intersection.

b) Data for Tuesday evening is as shown in figure 5.2 below:







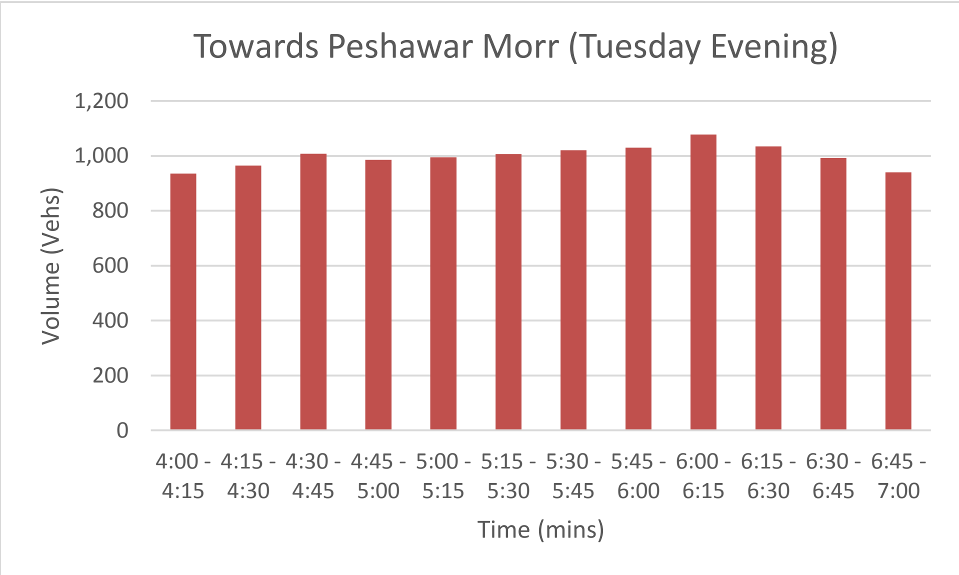
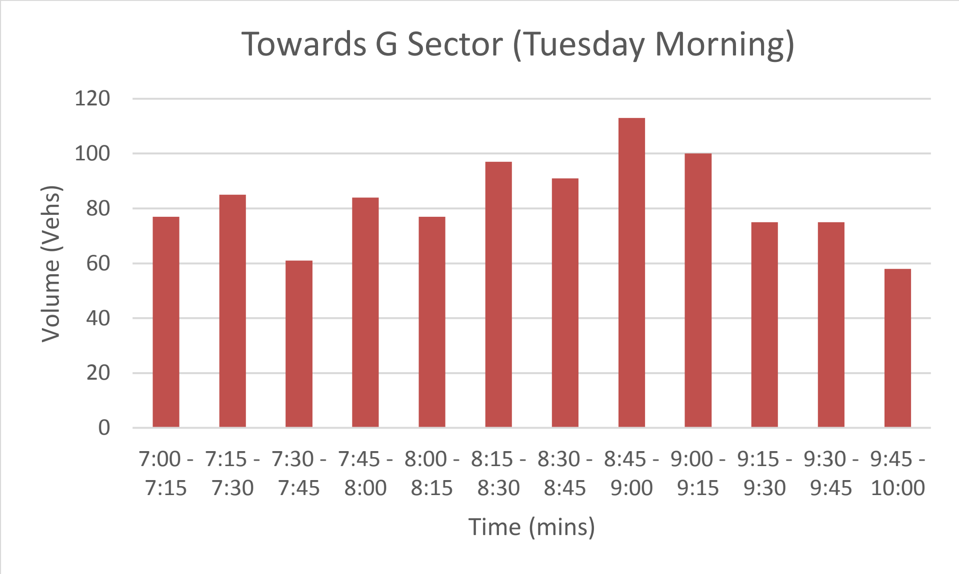
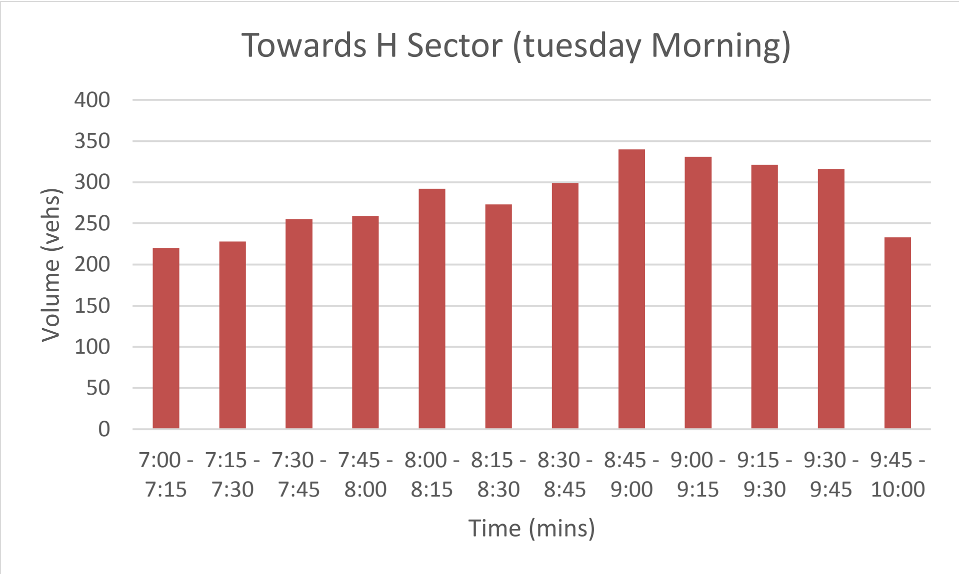


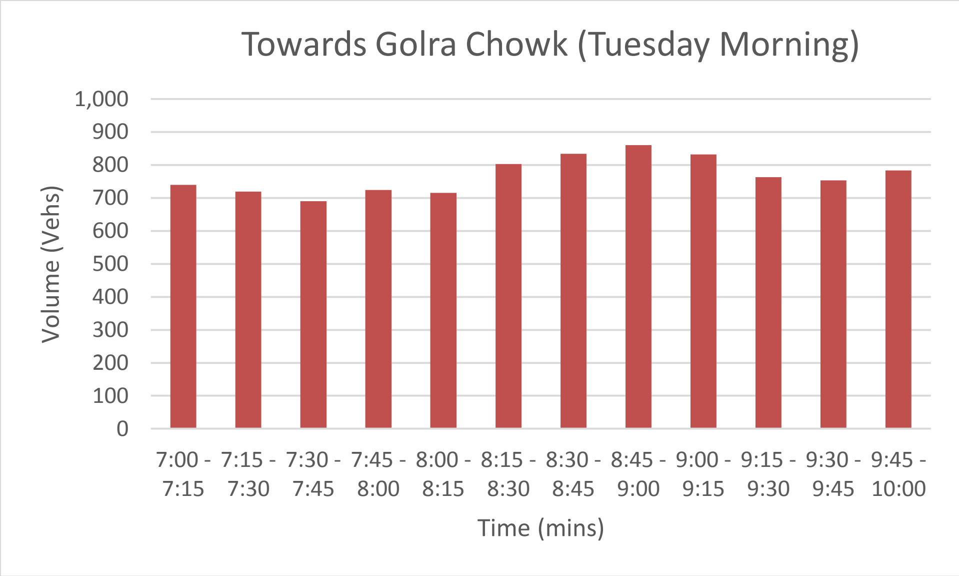
Figure 5.2 traffic counts of Tuesday evening

Peak hour traffic for Tuesday evening was in 05:30-06:30PM. Traffic counts observed during that period were 9535 vehicles entering the intersection.

c) Data for Tuesday morning is as shown in figure 5.3:







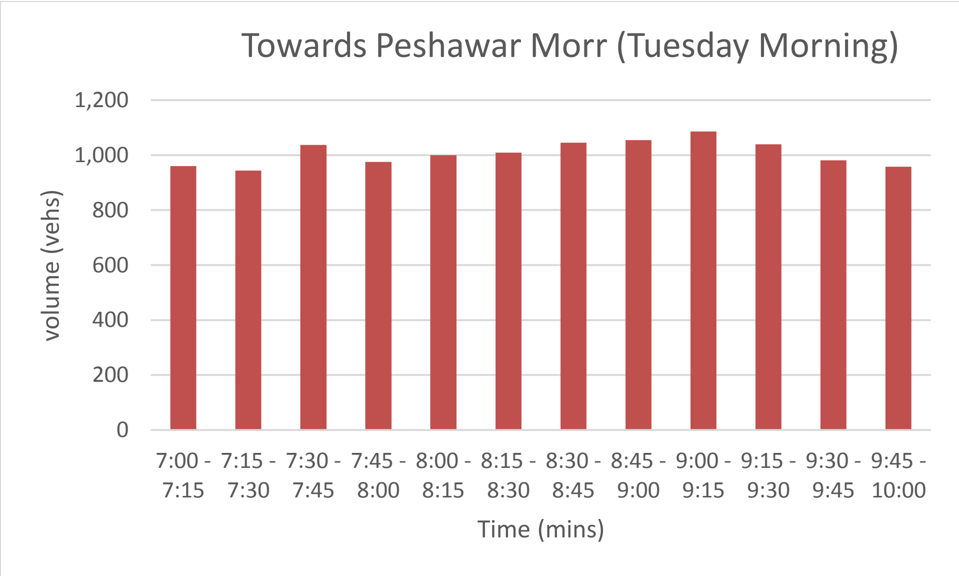


Figure 5.3 traffic counts of Tuesday morning

Peak hour traffic for Tuesday evening was in 08:30-09:30AM. Traffic counts observed during that period were 9185 vehicles entering the intersection.

5.4 Peak Hour factor

"The Peak Hour Factor (PHF) is the hourly volume during the maximum-volume hour of the day divided by the peak 15-minute flow rate within the peak hour: a measure of traffic demand fluctuations within the peak hour"

EXCEL was used to calculate Peak hour factor for different approaches and are as shown in table 5.1 below:

Table 5.1 Peak Hour Factor for Existing Approaches

Approach	Movement	PHF
Towards Golra Chowk	R	0.984
	TH	0.983
	L	0.984
Towards H sector	R	0.954
	TH	0.894
	L	0.963
Towards G Sector	R	0.862
	TH	0.926
	L	0.872
Towards Peshawar Morr	R	0.945
	TH	0.982
	L	0.956

5.5 VISSIM Results

Existing layout plan of 12th Avenue was modeled in VISSIM 9. Results were calculated and managed. Figure 5.4 (a) & (b) shows the VISSIM model of existing conditions at 12th Avenue. It has 10 lanes (5 lanes each side) Kashmir Highway and 12th Avenue crossing it with 2 lanes a side. The intersection is being controlled by pre-timed traffic signals. The signal timings are 45 seconds for Kashmir highway and 35 seconds for H sector bound traffic and 20 seconds for G sector bound traffic. Total cycle length is 160 seconds.

Figure 5.4(a) VISSIM Model (existing)

Figure 5.4(b) VISSIM Model (existing)

a) Vehicles Delays

Vehicle delays were calculated using PTV VISSIM 9. These delays are calculated by the software by taking difference of the time needed by the vehicle to complete one route traveling on design speed and time taken by vehicle in existing condition. Vehicle delay timings for Different Routes are shown in table 5.1.

Table 5.2 Vehicle Delays (existing)

Movement	Vehicle Delay (Average) (s)
G sector - Golra Chowk	88.64
Peshawar Morr - G sector	95.34
H sector - G sector	81.64
G sector - Golra Chowk	67.21
Peshawar Morr (U turn)	75.27
Peshawar Morr - Golra chowk	61.74

b) Queue Lengths

Queue lengths for different Approaches were calculated using PTV VISSIM 9. Queue lengths for different approaches were not acceptable and results are shown in table 5.2.

Table 5.3 Queue Lengths (existing)

Approach	Max. Q length (m)
Golra Chowk Bound	238.58
Peshawar Morr Bound	298.46
G Sector Bound	17.47
H Sector Bound	80.18

c) Existing LOS

LOS was calculated using VISSIM 9. Data collected was the input to the software after designing the Existing intersection layout in PTV VISSIM 9. For most of the vehicle routes “LOS F” was calculated by the software. Results are shown in Table 5.4 below. VISSIM calculate these results on the basis of Vehicles delay time.

Table 5.4 Level of Service (existing)

Approach	LOS (All)
Golra Chowk Bound	F
Peshawar Morr Bound	E
G Sector Bound	F
H sector Bound	D

5.6 Analysis of Results

After reviewing the results compiled by VISSIM 9, it was concluded that the intersection in peak hour times is operated in conditions that are not acceptable by the consumers and LOS maintained is very low, i.e. “LOS F”.

Therefore, keeping in mind the LOS currently provided and Vehicles delay calculated using VISSIM, it is necessary to improve the traffic progression at this intersection and thereby improving it on Kashmir Highway as a whole.

Chapter 6

PROPOSED SOLUTIONS

6.1 Introduction

After analyzing the existing situation at Intersection, it was concluded that the improvement of the intersection is necessary as far as importance of Kashmir Highway to twin cities is concerned. The delays caused by the intersection to the traffic and at an arterial linking two major cities are not acceptable.

There are two type of interventions that can be done to improve the situation.

i) Minor Interventions
ii) Major Interventions

6.2 Minor Interventions

Following Minor interventions were considered and Results were generated after applying them using VISSIM 9.

a) Improvement of traffic Signals.
b) Providing additional lanes at congested areas.

6.2.1 Improvement of traffic signals

Traffic signals at the intersection were not updated according to the survey conducted and there was a lot of time wasted within the signal timings. Serving the lanes with lesser volumes for more time and ignoring the through traffic.

Solution to this problem was to recalculate traffic signal timings for different approaches at different timings and use varying timings for different hours to optimize traffic progression. This was done using VISSIM 9. Software gives an option of automatically re-adjusting signal timings for different approaches and it was used to calculate timings and it improved traffic conditions at intersection significantly.

6.2.1.1 Results

Results were calculated using VISSIM 9 and are shown underneath.

a) Delay Times

Delay times were reduced after the improvement of traffic signals. Reduction in average delay per vehicle is significant and jut by improving the current situation of traffic Signals overall progression of traffic can be improved. These results are shown in the Table 6.1 Vehicle delays Improved Signal

Table 6.1 Vehicle delays Improved Signal

Movement	Vehicle Delay (Average) (s)
G sector - Golra Chowk	88.64
Peshawar Morr - G sector	95.34
H sector - G sector	81.64
G sector - Golra Chowk	67.21
Peshawar Morr (U turn)	75.27
Peshawar Morr - Golra chowk	61.74

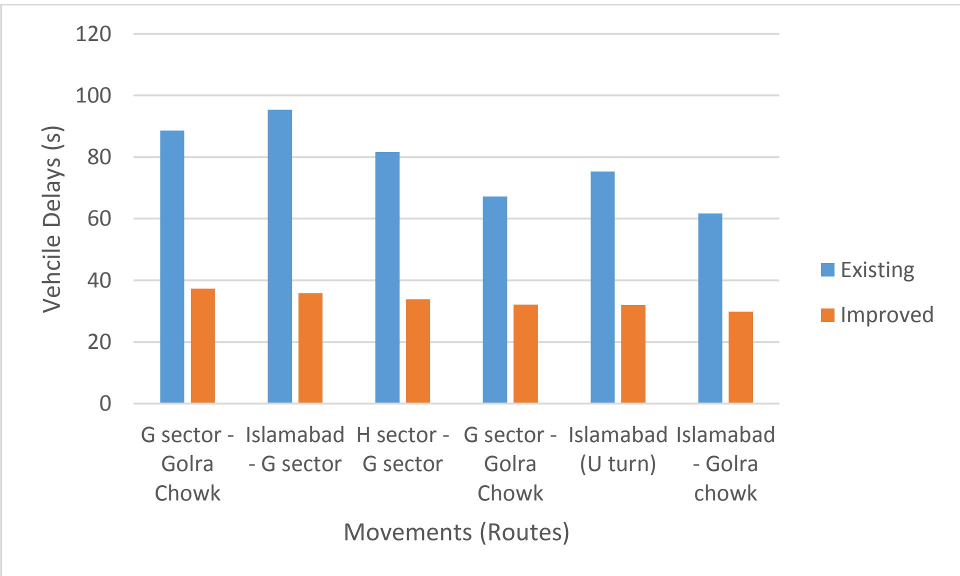


Figure 6.1 Vehicle delays (existing vs. improved Signal)

Figure 6.1 shows vehicle delays of existing conditions when compared with improved signals.

b) Queue Length

Queue lengths were also reduced to some extent and it helped improved the intersection. Queue lengths were reduced to almost half as results are shown below in the table 6.2.

Table 6.2 queue lengths improved signal

Approach	Max. Q length (m)
Golra Chowk Bound	238.58
Peshawar Morr Bound	298.45
G Sector Bound	17.47
H Sector Bound	80.18

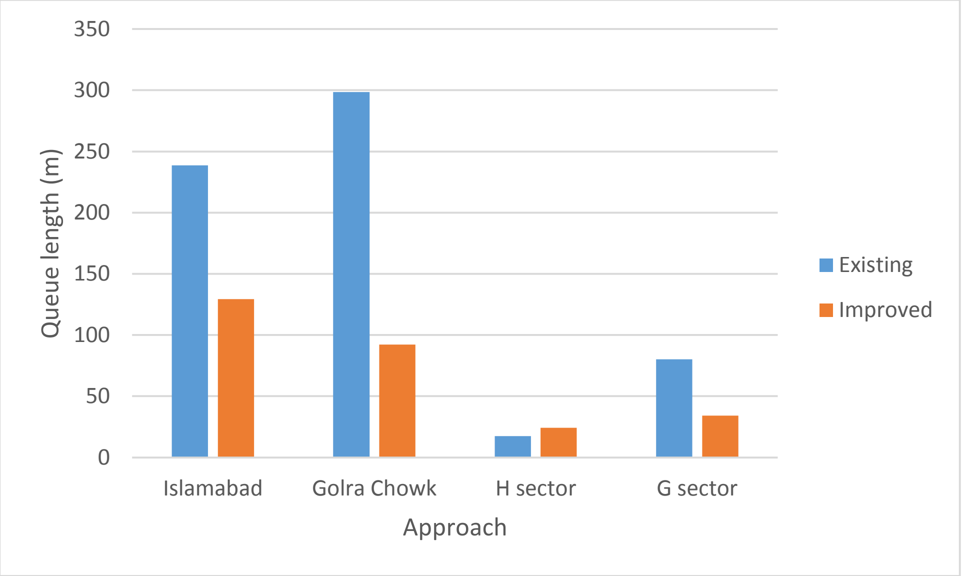


Figure 6.2 Queue Length Comparison (Existing vs. Improved Signal)

Figure 6.2 compares Queue Lengths of existing and proposed scenarios. The comparison shows that Queue length is decreased after improving signals in the existing Project.

c) Level of Service

Level of service (LOS) at the intersection was also improved. It is not a huge difference but improvement in this regard is also seen. Results are shown in the table 6.3.

Table 6.3 Level of service (Improved Signal)

Approach	**LOS (All)**
Golra Chowk Bound	D
Peshawar Morr Bound	C
H sector Bound	D
G sector Bound	D

6.2.2 Providing additional lanes at congested approaches and exits

Providing additional lanes at different location of the intersection was also a solution to the existing LOS at intersection. Additional lanes were provided at a G-sector approach and at the exit of G sector. It was to ensure the traffic progression at intersection and encounter the delays of traffic due to the congestion at specific lane group in Peak Hour times.

6.2.2.1 Results

After providing additional lanes at congested approaches and exits a marginal improvement in traffic stream was recorded. Results were calculated after improving traffic conditions and are shown below.

a) Vehicle Delays

Additional lanes where need when provided reduced average vehicle delay marginally. Vehicle delays were improved after the changes. It didn't make the huge difference but still were impactful. Results are shown in table 6.4 below.

Table 6.4 Vehicle delays (Improved lane)

Movement	Vehicle Delay (Average) (s)
G sector - Golra Chowk	78.23
Peshawar Morr - G sector	86.24
H sector - G sector	65.96
G sector - Golra Chowk	58.32
Peshawar Morr (U turn)	69.14
Peshawar Morr - Golra chowk	54.61

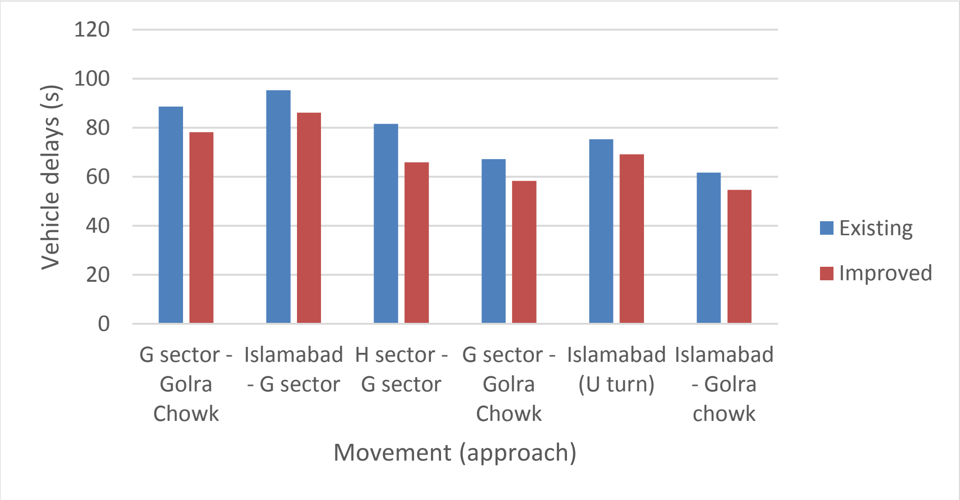


Figure 6.3 Vehicle Delays (Existing vs. Improved lane)

Figure 6.3 compares vehicle delays between existing and improved conditions. There's not much improvement in this regard.

b) Queue length

Queue length was reduced substantially and results are shared in table 6.5 below. These results show that after providing additional lanes queue length was reduced.

Table 6.5 queue lengths (improved lane)

Approach	Max. Q length (m)
Golra Chowk Bound	285
Peshawar Morr Bound	236
H sector Bound	35
G sector Bound	126

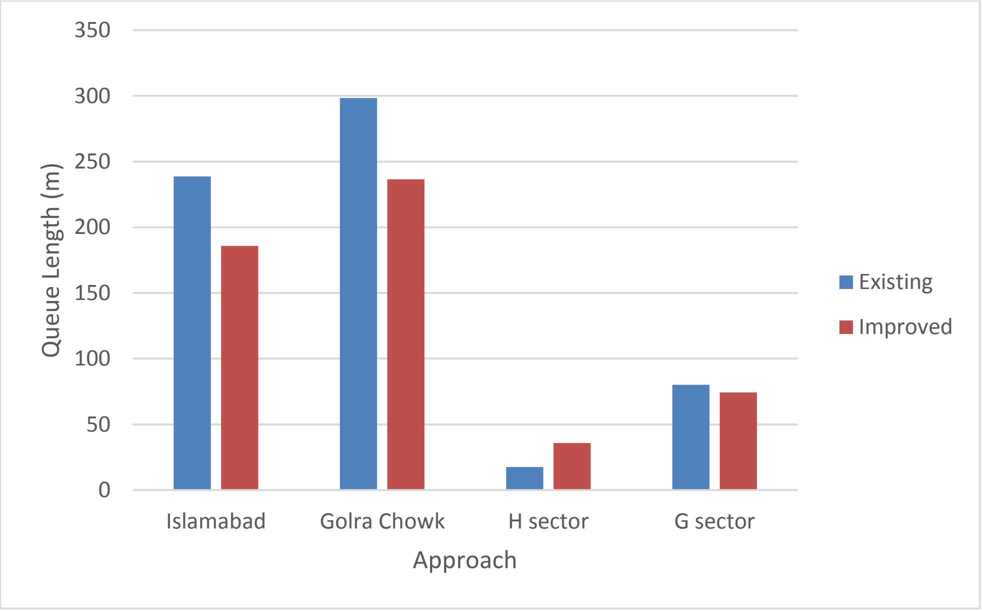


Figure 6.4 Queue lengths (existing vs. improved lane)

Figure 6.4 compares the results to existing condition and there is not much improvement by adding just a lane.

C) Level of service

Level of service of the intersection was improved a bit and it is illustrated in the results below. Results shown in table 6.6 expalins that level of service wasn't improved significantly but to some extent it was useful.

Table 6.6 Level of service (Improved lane)

Approach	**LOS (All)**
Golra Chowk Bound	D
Peshawar Morr Bound	F
H sector Bound	E
G sector Bound	F

6.3 Major Interventions

Major Interventions are the modification to a traffic system to improve its progression drastically and to provide a better option for future traffic planning. These type of interventions include providing multi grade facilities, underpasses, flyovers, or roundabouts.

Two proposed alternatives for the intersection at 12th avenue-Kashmir Highway are discussed below. These two alternatives are:

a) Provide 3-lane underpass with traffic signals.
b) Provide 3-lane underpass with a central roundabout.

6.3.1 Provide 3-lane underpass with traffic signals

Providing a 3 lane underpass at 12th avenue will reduce traffic delays at the intersection significantly. Through route for traffic progressing to and from Islamabad and Motorway/Airport will benefit most from it as these are the higher traffic volumes and should be given priority in the traffic stream.

6.3.1.1 Design parameters

Following Design Parameters were set for this proposed option:

- Underpass should be provided for Islamabad – Golra Chowk Route because of higher volume of traffic on the route.
- 3 lanes each side which should be 12 ft. each.
- Remaining traffic should use the intersection above underpass.
- Intersection must include traffic signal program to ensure traffic progression.
- Maximum grade for the underpass should be 4% so that busses can also use the intersection.
- Design speed is to be set at 80 kmph & 60 kmph for through traffic using underpass for LTV and HTV respectively.
- Design speed of 50 kmph for other traffic is proposed.

Figure 6.5(a) and 6.5(b) shows the VISSIM model of proposed underpass with traffic signals.

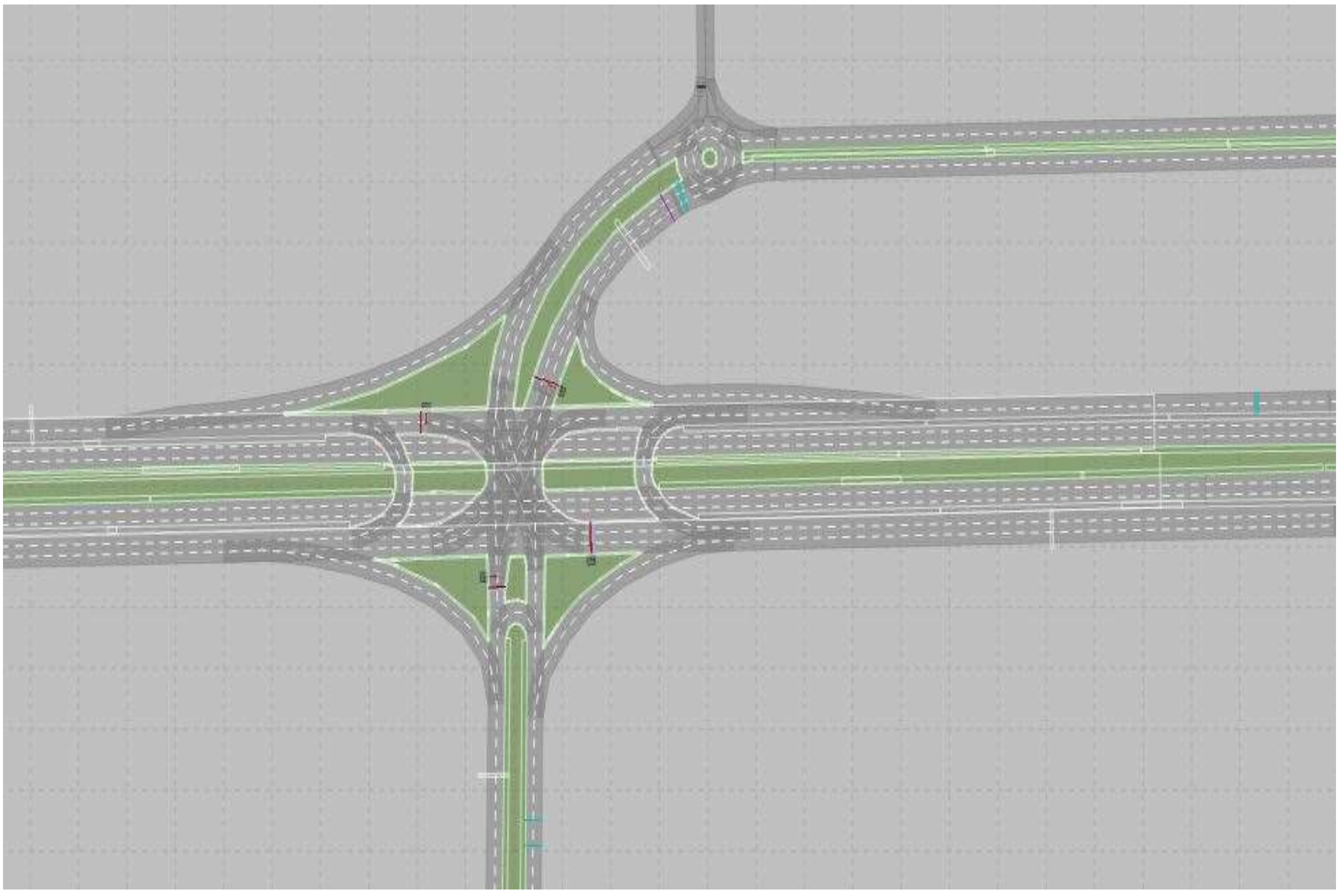


Figure 6.5(a) 2-D VISSIM model of proposed underpass

Figure 6.5(b) 3-D VISSIM Model underpass with intersection

6.3.1.2 Existing Prospect

6.3.1.2.1 Results and analysis

A traffic network using above parameters was designed in PTV VISSIM 9 and results were obtained using nodes and Queue counters. These results showed a huge improvement in traffic stream conditions at the intersection and results were convincing.

Results obtained are shown below using different Parameters.

a) Queue lengths

Queue lengths at the intersection were reduced and are shown in the table 6.7 below.

Table 6.7 Queue Length (Proposed underpass)

Approach	**Q length Max (m)**
Peshawar Morr Bound	29.06
H sector Bound	24.65
Golra Chowk Bound	24.12
G sector Bound	14.29

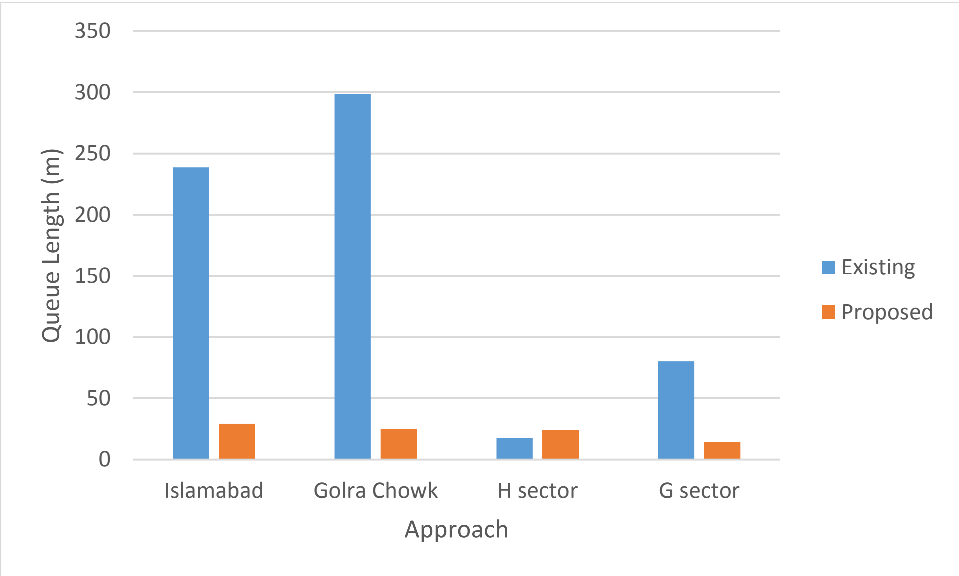


Figure 6.6 Queue Lengths (Existing vs. Proposed Underpass)

Queue length showed in the table 6.7 and figure 6.6 above depicts that it made huge difference as max. Q length at the existing condition was approx. 300. The reduction in queue length is huge and traffic progression was improved heavily. These queue lengths due to traffic signals provided at intersection and traffic signals are provided due to the driving behaviors of our nation.

b) Vehicle delays

Vehicle delays at the intersection were improved drastically too and are shown in the table 6.8 below:

Table 6.8 vehicle delays (Proposed Underpass)

Movement	Vehicle Delay (Average) (s)
G sector - Golra Chowk	12.75
Peshawar Morr - G sector	13.51
H sector - G sector	12.72
Islamabad (U turn)	4.87
Peshawar Morr - Golra Chowk	0.48

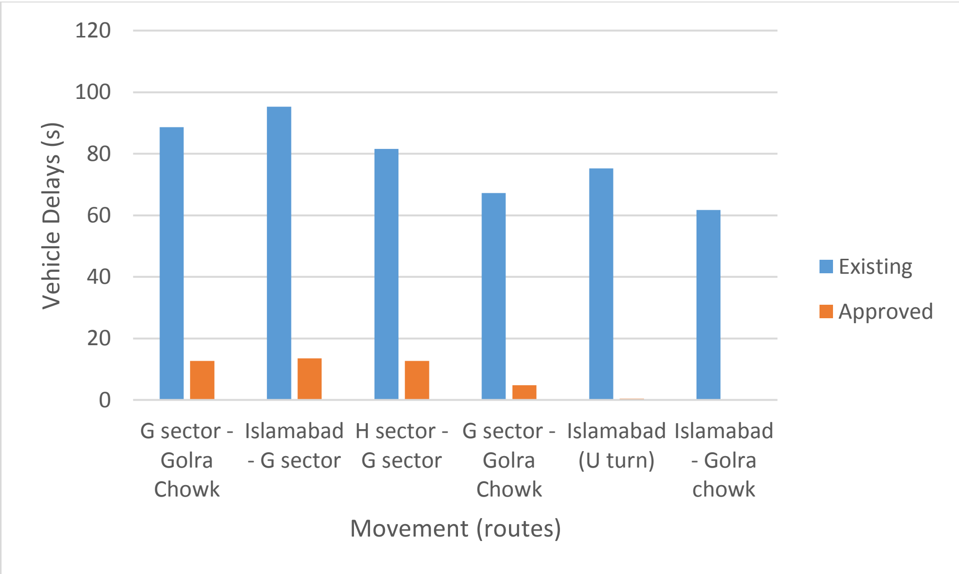


Figure 6.7 vehicle delays (existing vs. proposed underpass)

In figure 6.7 the results shown depicts that the traffic stream conditions were improved and vehicle delays were reduced too. Vehicle delays were very high in existing conditions and were reaching around 100 seconds (in an hour of peak conditions).

c) Level of service (LOS)

Level of service (LOS) was improved and the results are shown in the table 6.9 below.

Table 6.9 Level of Service (Proposed Underpass)

Approach	**LOS (All)**
Golra Chowk Bound	A
Peshawar Morr Bound	A
H sector Bound	B
G sector Bound	B

Level of Service (LOS) was improved drastically and it was “A” for the major approaches and “B” for the minor approaches. Level of service for existing conditions calculated by VISSIM were in the ranges of “E” and “F”. This huge difference is due to the fact that through traffic is not interrupted and lesser number of volumes are entering intersection and less conflict areas are formed.

6.3.1.3 Future Prospect:

Traffic in twin cities is increasing at an alarming rate and in near future when traffic volumes are increased this intersection is bound to be jammed in peak hours and will cause large traffic queues and vehicle delays. This proposed solution can be used for next 10 years and still LOS will not fall below “LOS C”, which is acceptable for an urban intersection.

6.3.1.3.1 Results and analysis

Traffic volumes for next 20 years were calculated and traffic Input was changed in VISSIM 9 and results were calculated. Results are shown below.

a) Queue length

Queue lengths were affected by the high traffic volumes but still there was smooth traffic progression. Results are shown in table 6.10 below:

Table 6.10 Queue lengths proposed underpass (future)

Approach	Q length (m)	Q length Max (m)
Peshawar Morr Bound	7.196501	48.22
H sector Bound	5.375567	38.50
Golra Chowk Bound	18.043663	69.52
G sector Bound	4.119412	38.87

b) Vehicle delays

Vehicle delays results obtained were a little higher after higher traffic input and are shown below. Table 6.11 shows the results below:

Table 6.11 Vehicle Delays proposed underpass (future)

Movement	Vehicle Delay (Average)
G sector - Golra Chowk	25.42
Peshawar Morr - G sector	30.36
H sector - G sector	12.85
Islamabad (U turn)	4.91
Peshawar Morr - Golra chowk	0.98

c) Level of service

LOS was affected by the higher traffic volumes but they are still acceptable as there's only 1 LOS C and rest are B and A. which are acceptable for an urban intersection. Table 6.12 shows the results of level of service.

Table 6.12 Level of Service proposed underpass (future)

Approach	LOS (All)
Golra Chowk bound	A
Peshawar Morr Bound	A
H Sector Bound	C
G Sector Bound	B

d) Analysis

The future LOS and conditions of an intersection are a vital part of the intersection design. The above design proposed can be used for at least a life span of 10 years which can be extended by minor interventions such as lane increment and signal improvements.

6.3.2 Provide 3-lane underpass with a central roundabout

Providing a 3 lane underpass at 12th avenue will reduce traffic delays at the intersection significantly. Through route for traffic progressing to and from Islamabad and Motorway/Airport will benefit most from it as these are the higher traffic volumes and should be given priority in the traffic stream. Roundabout provided will reduce conflict areas and there will be no need of traffic signal for the existing volumes. Roundabouts will reduce overall delay timings of Vehicles and is another alternative of providing intersection with signals.

6.3.2.1 Design perimeters

Following are the recommended design perimeters for the intersection:

a) Underpass should be provided for Islamabad – Golra Chowk Route because of higher volume of traffic on the route.
b) 3 lanes each side which should be 12 ft. each.
c) Remaining traffic should use the intersection above underpass.
d) Maximum grade for the underpass should be 4% so that busses can also use the intersection.
e) Design speed is to be set at 80 kmph & 60 kmph for through traffic using underpass for LTV and HTV respectively.
f) Design speed of 50 kmph for other traffic is proposed.
g) Yield signs should be provided at proper places to ensure traffic progression.

VISSIM models of proposed underpass is shown in figure 6.8(a) and 6.8(b).

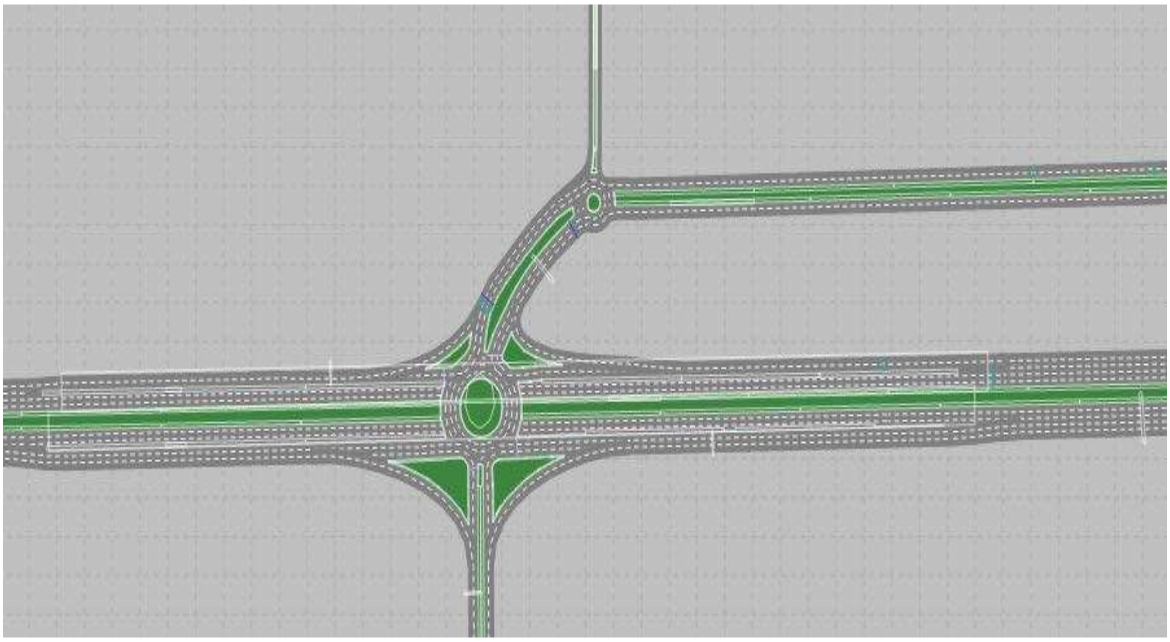


Figure 6.8(a) 2-D VISSIM model of proposed roundabout

Figure 6.8 3-D VISSIM model of proposed roundabout

6.3.2.2 Existing prospect

6.3.2.2.1 Results

A traffic network using above design perimeters was created in PTV VISSIM 9 and results were obtained using Nodes and Queue counters. The results showed that the above mentioned design perimeters significantly reduce traffic delays and queue lengths which in return improved LOS for the intersection.

a) Queue lengths

Queue lengths at the intersection were reduce significantly using an underpass with the roundabouts. The queue counters installed gave following results shown in table 6.13.

Table 6.13 Queue Length (Proposed Roundabout with Underpass)

Approach	Q length	Q length Max (m)
Golra Chowk Bound	0.246222	5.63
Peshawar Morr Bound	0.06333	7.98
H Sector Bound	0.229704	6.68
G Sector Bound	0.022609	5.12

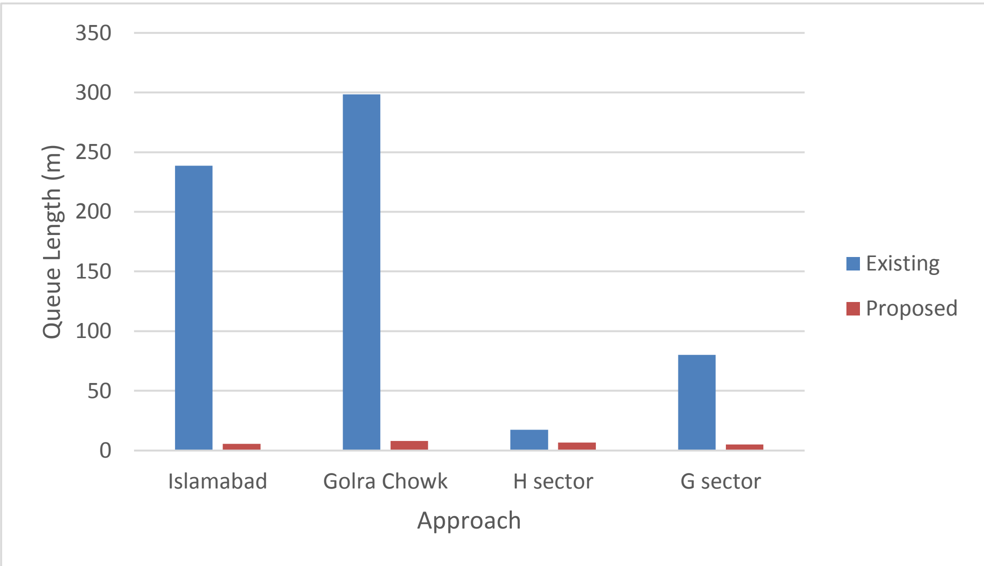


Figure 6.9 Queue Lengths (existing vs. Proposed Roundabout with Underpass)

Figure 6.9 shows queue lengths calculated for the existing intersection were reaching the figure of 300 and they were reduced to under 10 by this design. This significant change is due to the fact that through traffic was given priority a due to that overall traffic progression was improved in the intersection.

b) Vehicle delays

Vehicle delays were calculated using Node results. Results obtained were encouraging in a way that vehicle delays were reduced significantly using this design. The average vehicle delay for different routes are shown below in the table 6.14.

Table 6.14 Vehicle Delays (Proposed Roundabout with Underpass)

Movement	Vehicle Delay (Average) (s)
G sector - Golra Chowk	6.51
Peshawar Morr - G sector	6.79
H sector - G sector	2.3
Golra Chowk - H sector	8.92
Peshawar Morr - Golra chowk	0.23

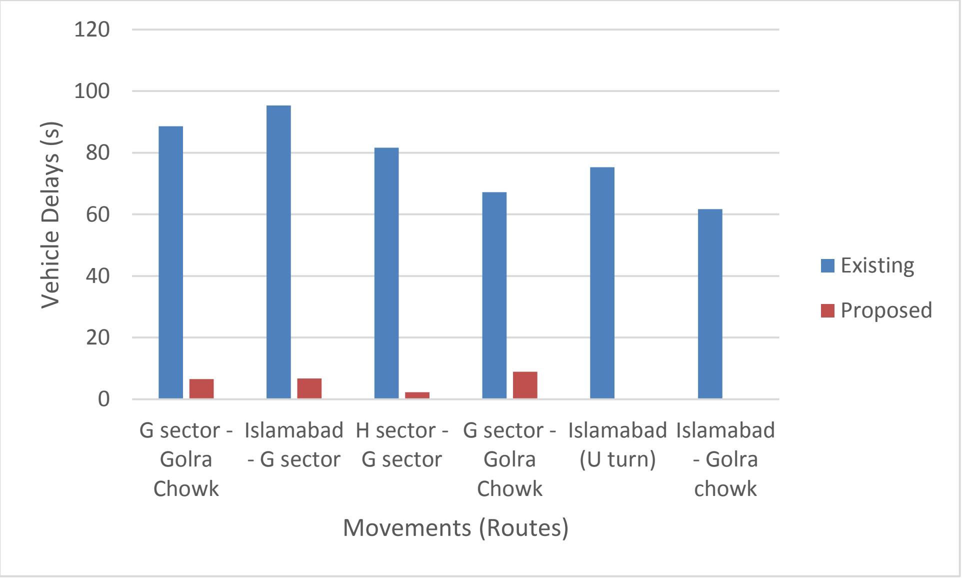


Figure 6.10 Vehicle Delays (existing vs Proposed Roundabout with Underpass)

Figure 6.10 shows Vehicle delays that were calculated for the existing conditions were in the region of 100s. The above results show that the average delay of vehicles in the proposed design were improved drastically.

c) Level of service:

Level of service calculated using above design perimeters showed improvement for every approach. Level of service in the existing conditions were LOS D, LOS E and LOS F. the current level of service after new design are shown in table 6.15.

Table 6.15 Level of Service of Proposed Roundabout with underpass

Approach	**LOS (All)**
Islamabad	A
Golra Chowk	A
G sector	A
H sector	A

Level of service calculated using node results in VISSIM 9 showed that the Level of Service was improved after the intersection's design was changed.

6.3.2.3 Future prospect

The calculated value of future traffic as per 4.5% expected growth rate of twin cities (as shown in Results and Analysis) were entered into VISSIM 9 as Vehicle input and results were calculated.

6.3.2.3.1 Results and analysis

Following results were obtained when input was changed in VISSIM 9.

a) Queue length

Queue lengths obtained from queue counters installed at different approaches are shown in the table 6.16 below.

Table 6.16 Queue Lengths of Proposed underpass with roundabout (future)

Approach	**Q length (m)**	**Q length Max (m)**
Golra Chowk Bound	0.531416	15.24
Peshawar Morr Bound	0.333875	9.79
H Sector Bound	0.239049	7.17
G Sector Bound	0.010747	5.19

b) Vehicles delay

Vehicles delay obtained from Node Results in VISSIM 9 are shown in the table 6.17 below. The delays weren't altered that much by the higher traffic volumes. These volumes

Table 6.17 Vehicle Delays of Proposed underpass with roundabout (future)

Movement	**Vehicle Delay (Average) (s)**
G sector - Golra Chowk	7.96
Peshawar Morr - G sector	10.03
H sector - G sector	7.95
Golra Chowk - H sector	10.93
Peshawar Morr - Golra chowk	0.91

c) Level of service

Level of service calculated from node results in VISSSIM 9 are shown in table below:

Table 6.18 Level of Service Proposed underpass with roundabout (future)

Approach	**LOS (All)**
Golra Chowk Bound	A
Peshawar Morr Bound	A
H Sector Bound	B
G Sector Bound	B

d) Analysis

Future prospect is a very important factor in the design of an intersection. Growth rate should be kept in mind while designing an intersection. The above proposed design is acceptable for next 10 years and can be utilized for another 10 years by just applying minor adjustments.

6.4 Environmental Factors

Environmental factors are very important as far as 21st century is concerned. High carbon and nitrogen gases emission from vehicles are causing greenhouse effect and ultimately rising the temperature of the earth. The effects of greenhouse gases on atmosphere is already an alarming situation for the citizens living in urban areas. Greenhouse gases are also directly harmful to the human body. Breathing CO can cause headache, dizziness, vomiting, and nausea. If CO levels are high enough, you may become unconscious or die. Controlling these type of gases and controlling the emission is duty of all of us.

Node results of existing and proposed solutions are compared with respect to the environmental factors below. These results were calculated for similar Node areas and for same amount of traffic simulation.

6.4.1 Results:

Results obtained are shown below and compared.

a) Emissions Carbon monoxide

Results shown in the Figure 6.11 below compares the results of emissions of CO in the node.

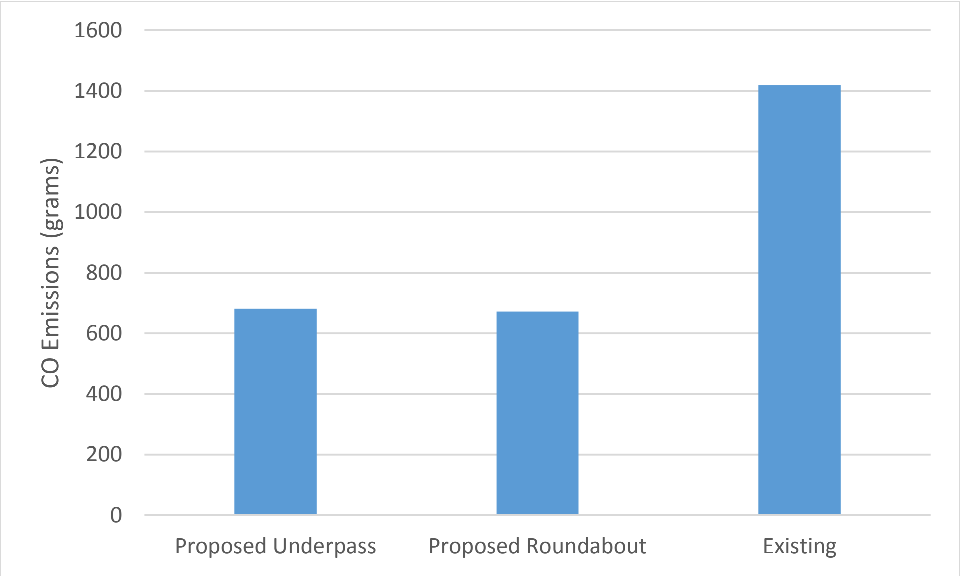


Figure 6.11 CO emissions

b) Emissions NOx

Results shown in the Figure 6.12 below compares the results of emissions of NOx in the node

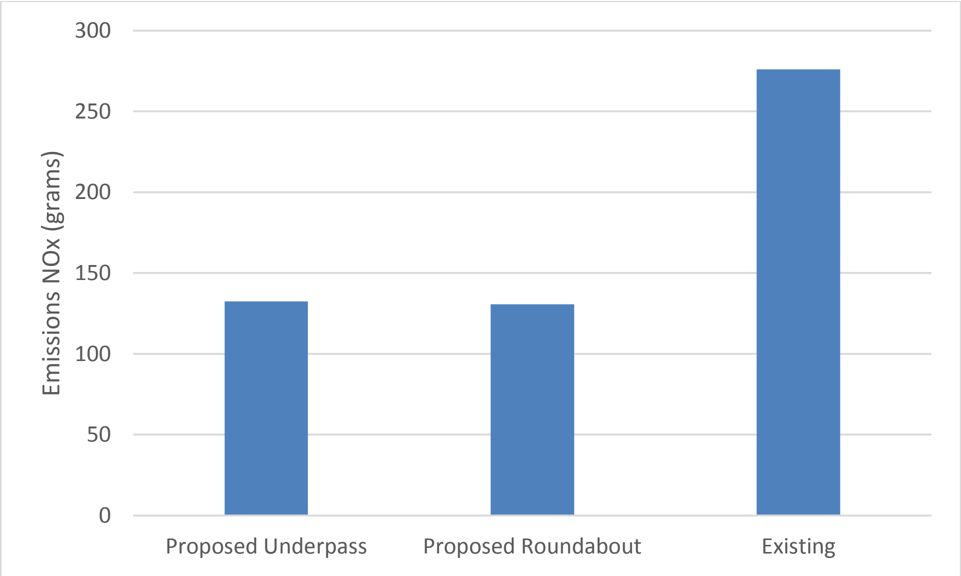


Figure 6.12 Emissions of NOx

c) Emissions VOC

Results shown in the Figure 6.13 below compares the results of emissions of VOC in the node.

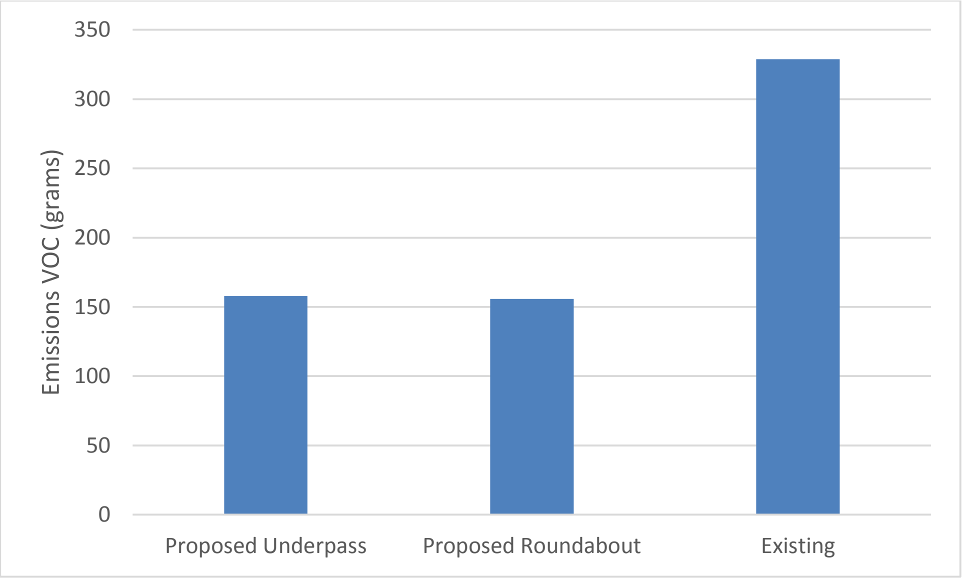


Figure 6.13 Emissions VOC

d) Fuel consumption

Results shown in the Figure 6.13 below compares the results of fuel consumption in the node.

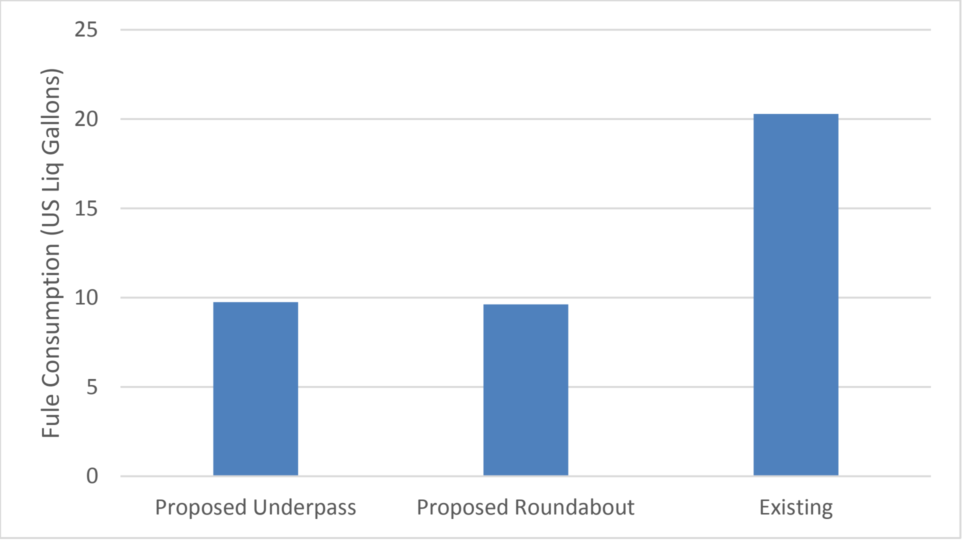


Figure 6.13 Fuel Consumption

Fuel Consumption shown in the figure above shows that in the Improved and proposed infrastructure changes consume less than half fuel consumed in existing conditions.

Chapter 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Summary

Our project was to analyze the 12th avenue intersection Islamabad with the purpose of improving the level of service provided by the intersection by proposing improvements i.e. minor interventions and infrastructure improvements. To enhance the current intersection conditions, it was important to know the existing parameters and conditions, survey at the intersection was done for this purpose. Then peak hour volume was determined with the help of collected data. The field data was carried out on two different days of the week with both morning and evening times. Furthermore the PHF (peak hour factor) was calculated. VISSIM software was used for the analysis of the results. With the help of this software existing vehicle delay, queue length and level of service of the intersection was determined. The existing conditions were then simulated again but with different interventions, which were minor interventions and major interventions. Minor interventions consisted of providing additional lanes at the intersection and improvement of the traffic signals by optimizing it. Major interventions included providing 3-lane underpass with signalized intersection and providing 3-lane underpass with a central roundabout. Simulations of all these interventions improved the LOS, vehicle delay and queue length as shown in previous chapters. After a detailed analysis and when future traffic volumes were input, and the best solution was by providing 3 lane underpass with a central roundabout. This intervention showed Level of service A, B when future traffic volumes of 10 years were fed into it.

7.2 Conclusions

The case study was based on the one of the major arterials of Islamabad and Rawalpindi. Based on the study following conclusions are drawn:

- 12th avenue Islamabad has serious traffic congestion issues as shown by VISSIM results with LOS D, E and F.

- After applying minor interventions and signals optimization technique the Level of Service can be increased to LOS C but it will decrease in future years.
- Proposed alternative of providing 3-lane underpass with traffic signals improves the current Level of service but after 10 years in some areas the Level of service drops to C.
- Proposed alternative of providing 3-lane underpass with a central roundabout improves the Level of Service to A, B even after adding the next 10 years volume.

7.3 Recommendations

Following recommendations are proposed based on study done on 12th Avenue.

- Cost analysis and Geometric design of the proposed Infrastructure to be prepared in the future
- Results to be shared with FWO, NLC and CDA (Capital Development Authority)
- Use of roundabouts instead of signalized intersections

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