
# Improvement of Traffic Progression A Signalized Intersection Using Vissim Simulations (Kacheri Chowk Rawalpindi) Capt Abdullah Ifzal

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**Project report submitted in partial fulfilment of the requirements for the degree of**

## BE CIVIL ENGINEERING

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## CONTENTS

## LIST OF FIGURES

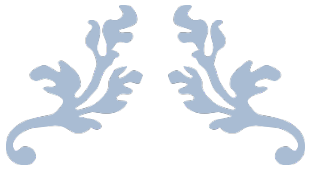
## LIST OF TABLES

# ABSTRACT

With the ever increasing traffic growth in the prevailing road network in urban districts and major towns, there exists a severe problem of jamming, interruptions, ecological hazards and high fuel consumption. Short term and long term solutions like construction of new roads, broadening of prevailing road networks, provision of raised fly over's, etc are constrained by finances and space availability. The precise estimation of traffic interruptions at signalized crossings is a key element for the planning, design and analysis of signal controls. The area selected for study and traffic surveys is Kacherichowk in Rawalpindi because of its close proximity to private and commercial activities.

Various traffic studies and surveys such as volume count, intersection inventory study, signal cycle length study has been carried out. The Study is performed to evaluate the current condition of Traffic, Hourly variations, Capacity and Level of Service (LOS). The traffic data is analyzed and results shows that Kacherichowk is always a crowded intersection at peak hours and operate at a much low level of service. Therefore, the purpose of this research work is to enhance the performance along with operation of Kacherichowk by assessing different options to improve the traffic capacity.

During the project, all the requisite data was collected manually using different survey equipment etc. Few soft wares like VISSIM and EXCEL were used for the analytical studies and also for the solutions to improve the traffic progression at this intersection. The outcomes of this research work will give different options and the most viable option will be suggested which can be at grade or grade separation or in the form of optimized signal timings.



# INTRODUCTION

# Chapter - 1
# Introduction

## 1.1 General:

Transportation and communication infrastructure are an important component of the economy and a common tool used for economic progression and enhancing production capacity of a country. Quantity and quality of transportation facilities and economic growth are directly related to each other. It has been universally acknowledged that countries with efficient transportation and communication infrastructure are more economically competitive and vibrant as compared to those having inefficient system. Communication network is an expression of the human aspiration to live in harmony and peace with other people. Roads and routes serve this purpose effectively.

Transportation projects can have numerouseffects on a community`s economic development goals, such as productivity, employment, business activity, property values, investment and tax revenues. In general, transport projects that increase accessibility (i.e., they improve businesses capability to provide goods and services, and people's ability to access education, employment and services) and reduce transportation costs (including travel time, vehicle operating costs, road and parking facility costs, accident and pollution damages) tend to increase economic productivity and development.

Traffic congestion inhibits vehicles from traversing freely on the transportation network. Therefore, vehicles travel at reduced speeds in a congested system and optimum utilization of the road network hinders. Traffic congestion occurs because of following reasons: (1) when a traffic volume or choice of mode (modal split) creates a demand greater than the capacity:

the saturation point, (2) zone regulation: restricted number of motorists on a given segment, causing a majority of them to occupy one particular segment or intersection, (2) vehicles parked at no parking zones thereby causing traffic flow interruptions, (3) Non-regulated intersections, (4) vehicle failures or accidents, (5) several motorists trying to use the same flow path simultaneously, (6) improperly designed signalized intersections also contribute towards traffic congestion.

Urban congestion is becoming a serious issue in Pakistan as well as other developing countries where urban and town planning has not been given due importance during planning stage of any development project, thereby causing congestion at intersections. Planners and designers are left with quite few options to deal with such situations. Turn lanes, fully actuated signals, and signal controls have been employed for many years. Broadening and construction of new structures can be very costly and hazardous to the environment. Mass Transit, smart-Growth style transit-orientated development, efficient Demand management, and intelligent transportation systems are typically years away from making a significant effect on jamming. Five major substitutes that have been applied most often in the U.S. and/or have the most for travel time savings are median U-turn, jug handle, superstreet, continuous flow crossings, and quadrant roadway intersections.

However we have tried to relieve congestion by using alternatives which are signal free corridors and/or construction of flyover/underpass. We have made an endeavor to study whether congestion/jamming, can be relieved by adopting these alternatives.

## 1.2 Problem statement and motivation for study:

Congestion is a distinguished conundrum at intersections in urban setups, and is worsening because of expansion of personal/private vehicle ownership with every passing day. A handful amount of research has been carried out in this domain.

We selected our location based on the information we obtained from following sources:

a. CDA (Capital development authority)
b. Traffic police
c. Project advisor
d. General observation (As three of syndicate members are residents of Islamabad).

We analyzed the effect of construction of a flyover on the portion of intersection joining Lahore and Rawalpindi intersecting airport road. The primary cause for this traffic congestion is the remarkable difference between demand and capacity and existence of a network of several intersections within a radius of less than one kilometer and so this web is considered to be a tailback for a very large area of the financial hub.

Critical time was observed to be during 08:00 to 09:00 a.m. and 1:45 p.m. to about 3:00 p.m. on Fridays and 04:00 pm to 05:00 pm on Tuesdays. The reason for this hold up is the lunch time of offices and closure of schools and colleges at the same time and also the closing time of offices on Tuesdays. Another reason is the location of business centers in the close vicinity of Kacherichowk, which affected the geometry of some nodes extraordinarily.

We have attempted to investigate the traffic flow conditions at these intersections (Manually using JAMAR counter along with getting data from TRAFFIC POLICE and on software VISSIM 9.0) and have tried to define some substitutes and remedial measures to relieve congestion and improve traffic flow conditions at these intersections.

### 1.3 Aims and Objectives:

Our aims and objectives are as follows:-

a. Familiarization with the conduct of traffic survey at signalized and un-signalized intersections in urban areas.
b. Introduction and basic know how of software VISSIM 9.0 which simulates actual traffic flow conditions and analyze an intersection or network of intersections.
c. To learn how to study an intersection using Highway capacity manual.
d. Suggesting remedial measures or alternatives basing on our analysis.

### 1.4 Scope:

Our project encompasses analysis of an intersection including the data collection and calculation of saturation flows, capacities, and volume to capacity ratios, using Highway capacity manual.

Traffic surveys of all types are a complex and comprehensive process. It should be thoughtfully planned keeping in view the economic constraints. We collected following data from traffic surveys:-

a. Traffic counts.
b. Vehicle delays.
c. Signal timings.
d. Geometric data.

This traffic data, volumes, and volume to capacity ratio are the inputs for analysis of intersection which can be carried out manually using HCM 2000 or by software e.g. EXCEL or VISSIM.

We have used software VISSIM 9 for analysis and problem solving which simulates the actual field conditions by using various inputs and gives a variety of solutions for the existing problem. Selection of an appropriate and reasonable solution demands vast experience and professional expertise.

# LITERATURE REVIEW

# Chapter – 2
# Literature Review

## 2.1 Introduction:

This chapter is the amalgamation of the various studies and researches that have been carried out in the past in the field of traffic congestion, traffic conditions, its 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 is a major concern of metropolitan areas resulting in various trials undertaken to reduce 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:

a. Number of vehicles exceeding the design capacity.
b. Blockade on the roadway.

c. Inadequate intersection cycle length.
d. Traffic signal malfunction.
e. Excessive pedestrian crossing.
f. 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:

a. Capacity i.e. the total roads and the number of lanes.
b. Optimizing the road network such as optimizing signals.
c. 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 i.e.

a. At Grade Intersection

b. Grade Separated Intersection.

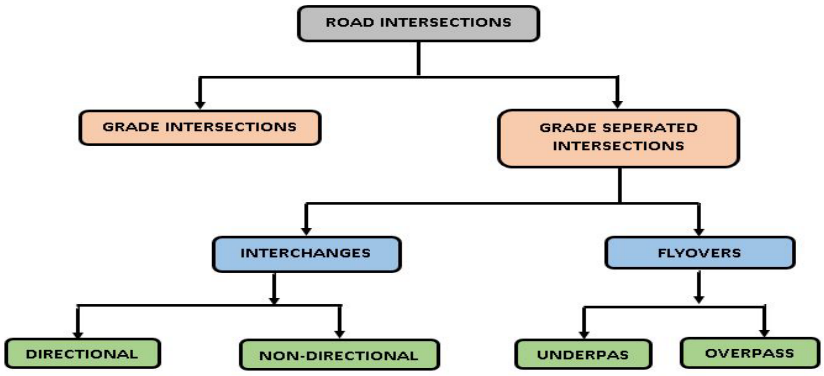



Figure 2.1Flowchart showing classification of intersections

### 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 builtto assist the movement of pedestrians to cross railroad.

Figure 2.2 Image showing an 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.

Figure 2.3 Images Showing an Overpass

### 2.4.1.3 Trumpet Interchange:

If one highway is terminating another highway, Trumpet interchanges are used. 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.

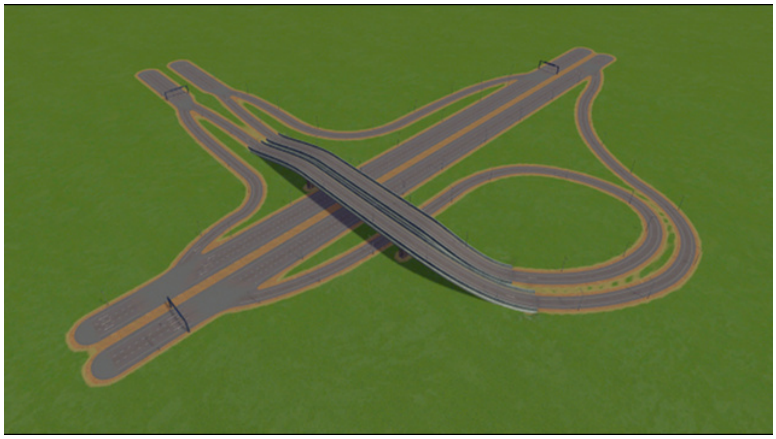


Figure 2.4 Image showing a Trumpet Interchange

### 2.4.1.4 Diamond Interchange:

The diamond Interchange is between two roadways as a simple form of grade separated intersection. 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.

Figure 2.5 Image showing a Diamond Interchange

### 2.4.1.5 Cloverleaf Interchange:

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.

Figure 2.6 Image Showing a 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.

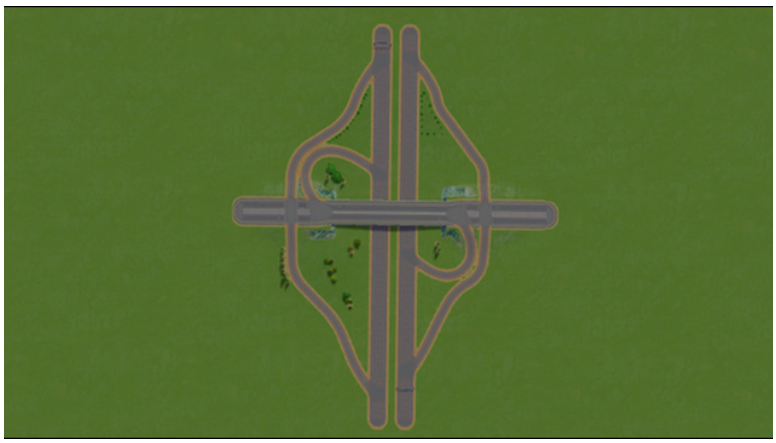


Figure 2.7 Image showing Partial cloverleaf interchange

# RESEARCH METHODOLOGY

# Chapter – 3
# Research Methodology

### 3.1 Introduction:

This part of the research work explains the research methodology adopted during the study to achieve the stated objectives. Research methodology or method to conduct a study is considered as “a strategy, design or process lying behind the choice of and use of particular methods” (Crotty, 2003:3). Its purpose is to explain and justify the use of particular methods (Wellington, 2000). The under mentioned flowchart shows the structure that was adopted for conduction of our study:

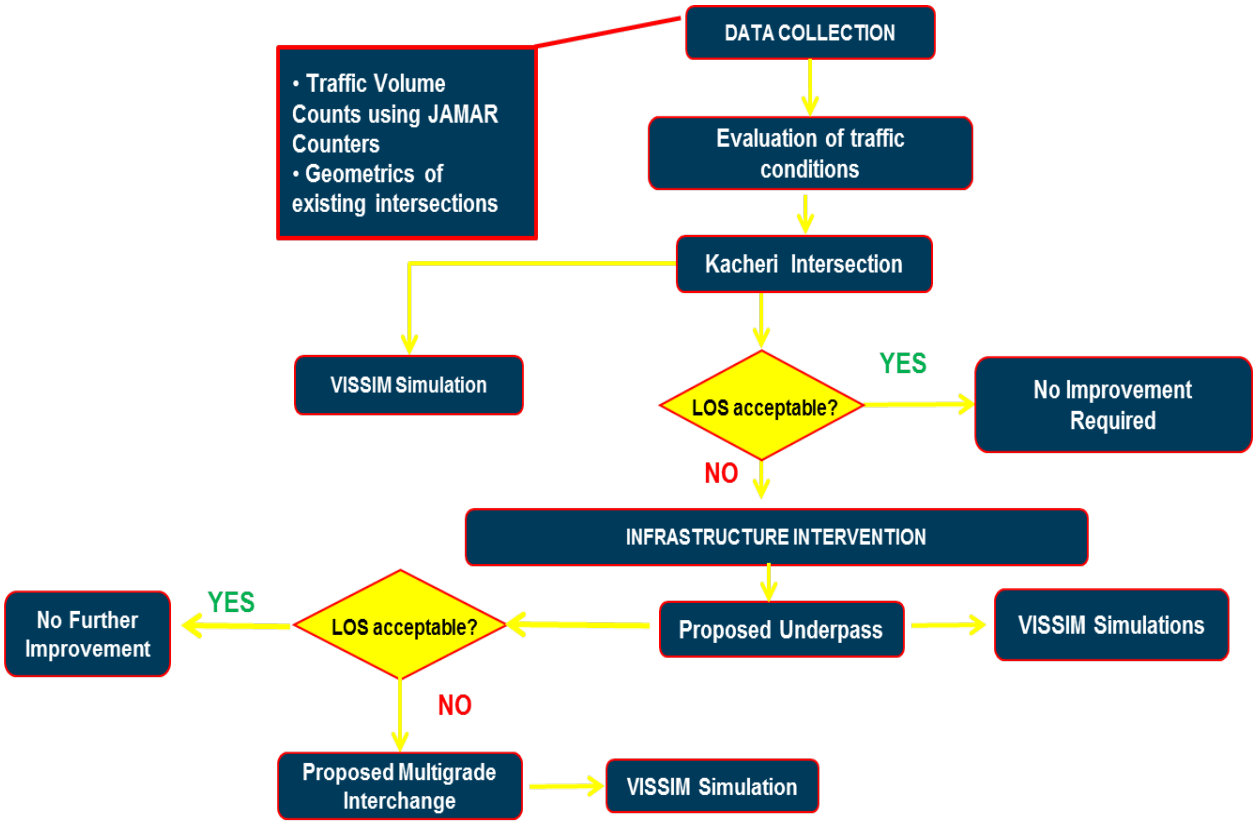



Figure 3.1 Flowchart showing methodology of the Project

### 3.2 Data Collection:

#### 3.2.1 Traffic Data Collection:

The tools/ instruments which were used for assessing the performance of the existing road network of KacheriChowk, Rawalpindi were traffic counts, turning volumes and geometric conditions. These were collected at all the four legs of the intersection i.e.Saddar Road, Airport Road, MareerHasanRoad, and road towards Lahore. The measurements were taken manually using JAMAAR counter from 07:00 am to 10:00 am in mornings and 03:00 to 06:00 pm in the evening of Sunday and Tuesday. Readings were also taken on Friday for 07:00 to 10:00 am and 12:00 to 03:00 pm in evening. It was found that the maximum road congestion and disorganized use of transportation facility occur during peak hours. A 15-minute interval was used for gathering traffic counts. The highest recorded traffic volume in each direction was used for the investigation. The vehicles were divided into two types:

a. Small vehicles: - any vehicle moving on three or four wheels including PC.

b. Large vehicles: - any vehicle moving on more than four wheels.

#### 3.2.2 Geometric Condition:

Urban signalized intersection geometry is displayed in illustrative / visual form which encompasses all of the pertinent data like the number and width of lanes, approach grades, and parking situations. Furthermore, the presence of right-turn or left turn lanes must also be especially observed, along with storage lengths of such lanes.

The on-site current geometric parameters which should be imperative for the investigation of KacheriChowk signalized intersection would be as under:

a. Area type
b. Number of lanes, N
c. Average lane width, W (ft)
d. Grade, G (%)
e. Existence of exclusive LT or RT lanes
f. Parking

### 3.2.3 Signalization Conditions:

A comprehensive data is required regarding signalization to perform such an investigation. This data embraces a phase layout demonstrating the phase plan, cycle length, green times, and change-and-clearance intervals.

The onsite prevailing signalization conditions parameters which should be imperative for the investigation of designated urban signalized intersection would be as under:

a. Cycle length, C (s)
b. Green time, G (s)
c. Yellow-plus-all-red change-and-clearance interval
d. (intergreen), Yellow (s)
e. Actuated or pretimed operation

## 3.3 Analysis of existing traffic conditions:

The above data is evaluated to draw the following parameters for determining the capacity of KacheriChowk:

a. Saturation flow rate using Highway Capacity Manual method
b. Peak hour volumes using Excel program
c. PHF using Excel program

### 3.4 Determination of LOS:

All the above parameters are put in VISSIM 9 software to determine the LOS of the above intersection. The intersection is signalized having pre-timed cycle lengths. After putting in the data the results were generated which gave the LOS of existing conditions.

### 3.5 Proposed Design Alternatives:

After the analysis of the LOS, time delay and Queue Length with the help VISSIM 9, it was concluded to suggest various design alternatives to improve the LOS. These alternatives consisted of short term and long term measures.

a. UNDERPASS with Roundabout: - As a short term measure, an underpass is suggested which will be economical and will enhance the existing LOS.

b. MULTIGRADE INTERCHANGE: - As a long term measure, a multigrade interchange is suggested. It will be abit expensive but will lead to much better LOS and will fulfill the future demand of the traffic increase.

### 3.6 Simulation of Traffic after Improvement:

The software PTV Vissim9was used for recreation of traffic flow before and after carrying out the required recommended infrastructure interventions. The results of simulations are in terms of time delay and Queue length which will give the LOS of suggested designs.

# ABOUT THE SOFTWARE

# Chapter -4
# Introduction to VISSIM

## 4.1 General:

VISSIM is software which is used for simulating traffic conditions and for generating various outputs. It is developed by Visual Solutions. The products of visual solutions have been rebranded as solidThinking Embed as a part of itsmodel based development program.Embed software automatically converts the diagrams into codes or files which can easily be downloaded on any required hardware device.

VISSIM or now solidThinking Embed uses data and represents it into graphical form, all the while using a dynamic system basing on differential equations to give the desired output.

## 4.2Getting Started VISSIM:

### 4.2.1 General Settings:

1. Go to base data then Network settings.

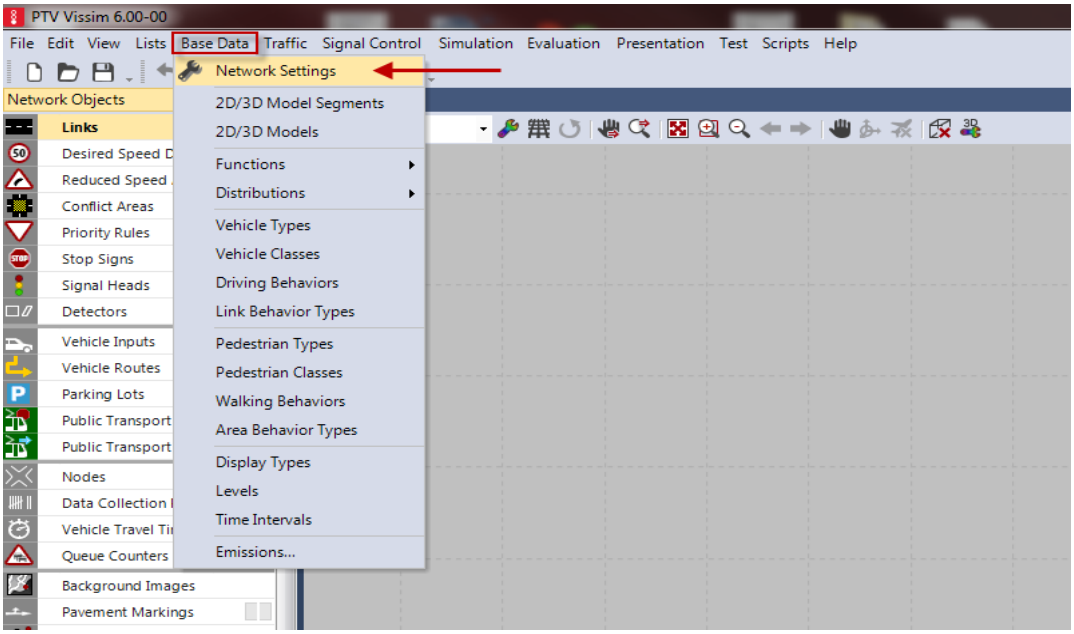



Figure 4.1 General Settings

2.Select the Units tab. Click **All Imperial**to change to English units.

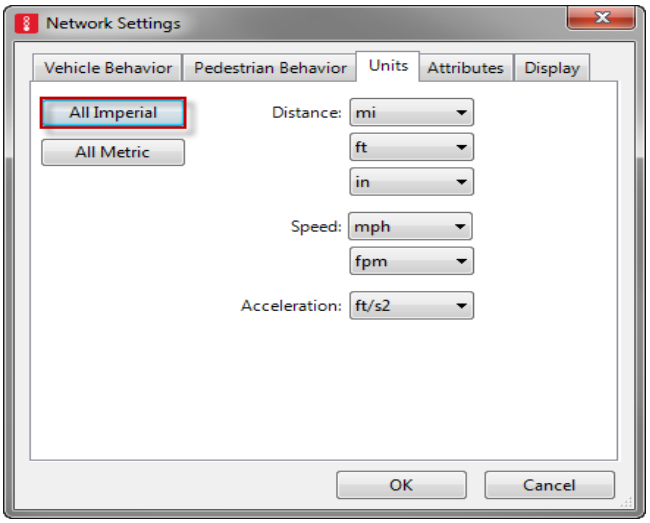



Figure 4.2 Change units

### 4.2.2 Build a Network:

1. Select **Background images** from the **Network Objects** side menu.

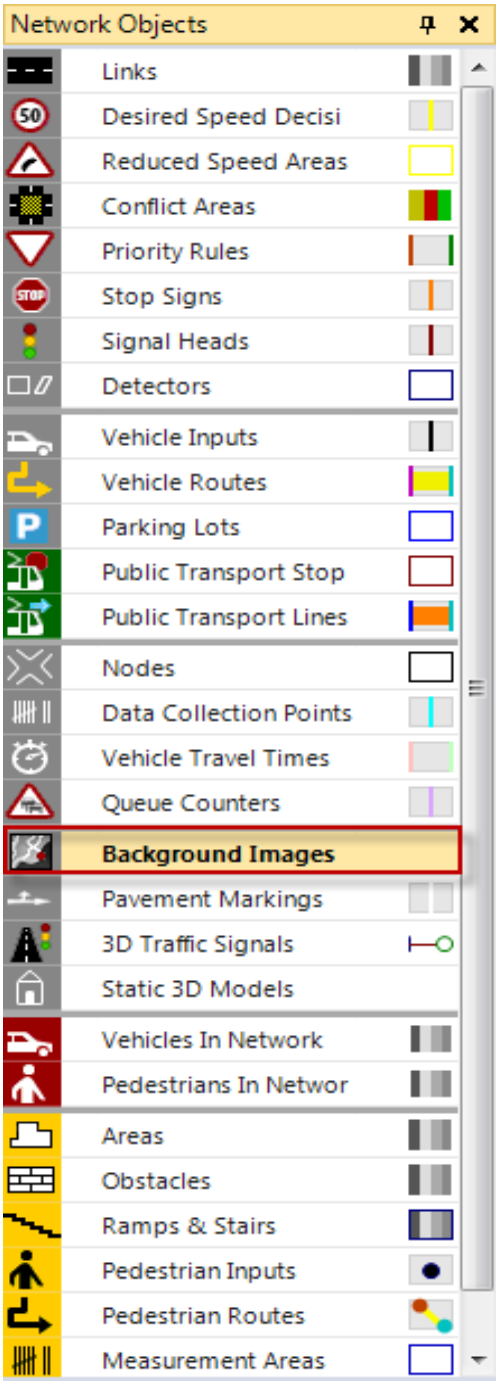



Figure 4.3 Build Network

2. Right click in the network editor window and select **Add New Background image**.

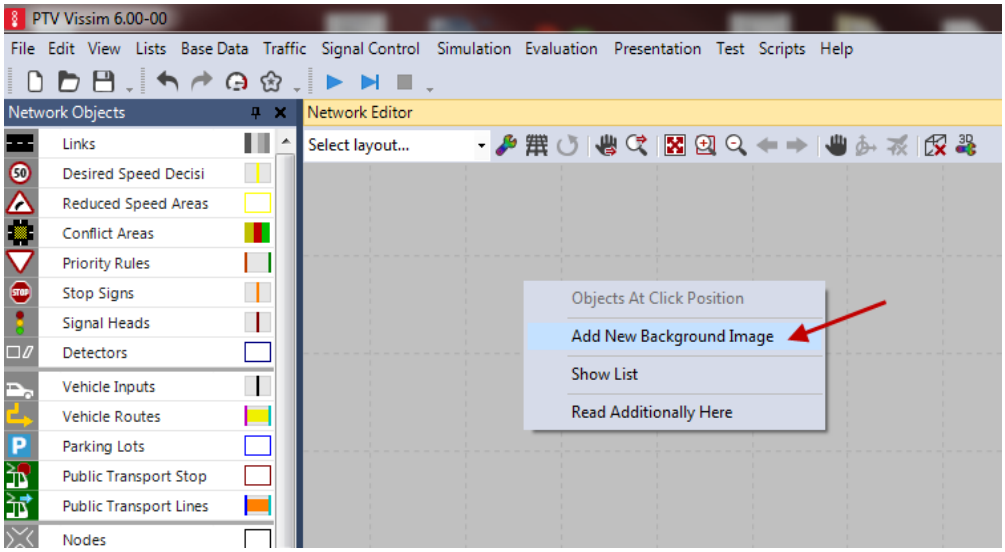



Figure 4.4 Adding Background Image

3. Enter the data in the following window.

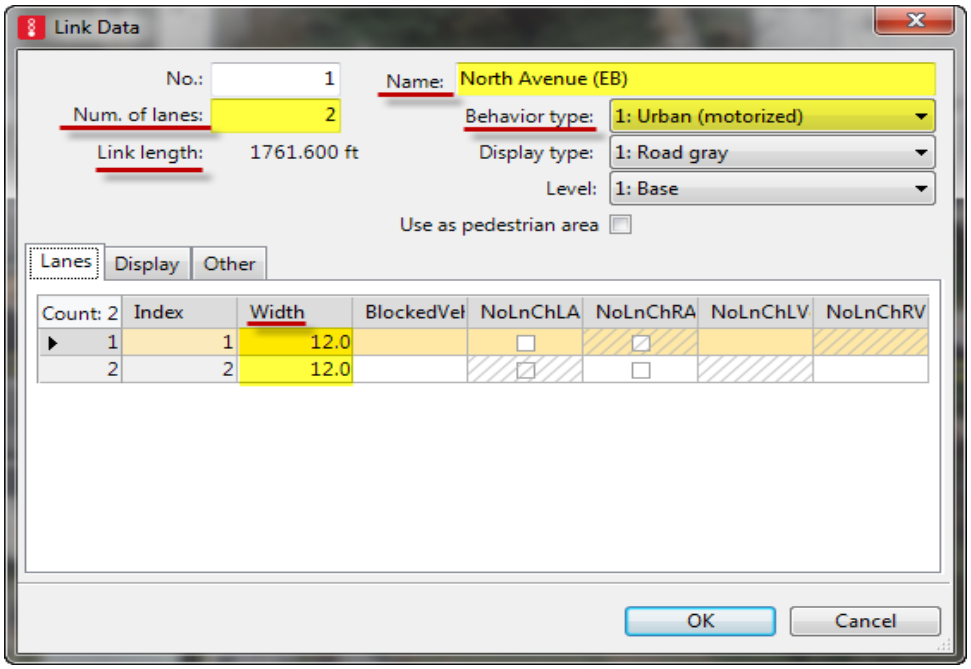



Figure 4.5 Addition of data for lane

4. Complete connector window.

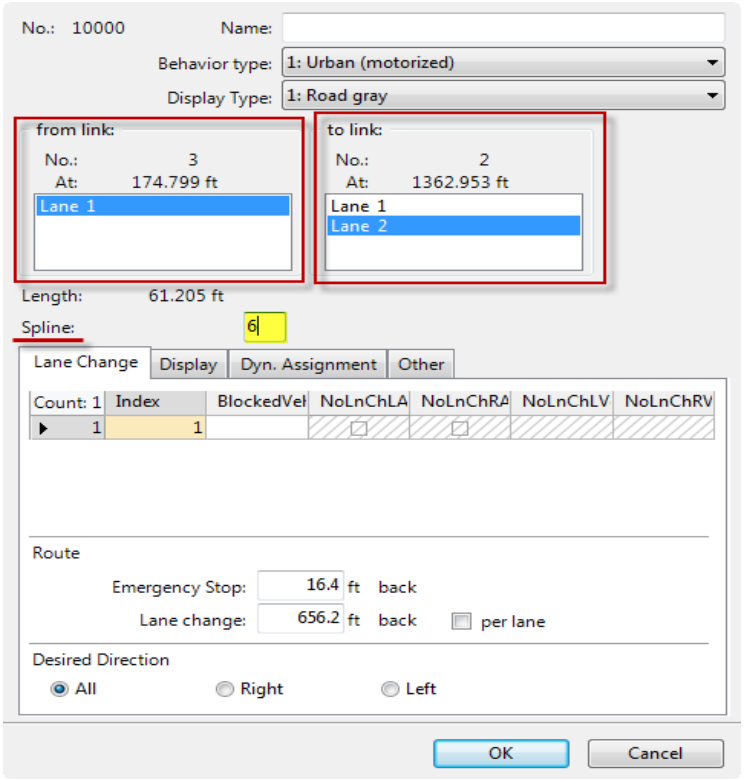



Figure 4.6 Making Connectors

### 4.2.3 Add Vehicles:

1. Go to traffic > vehicle composition.

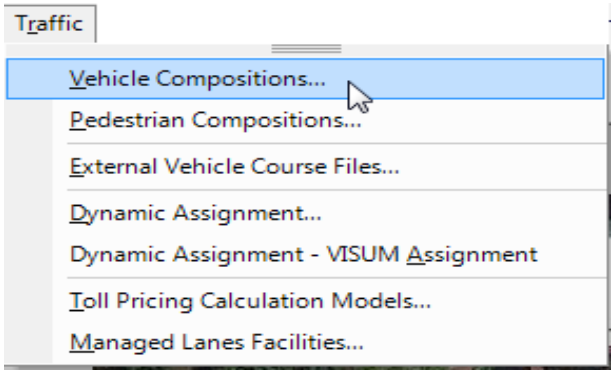
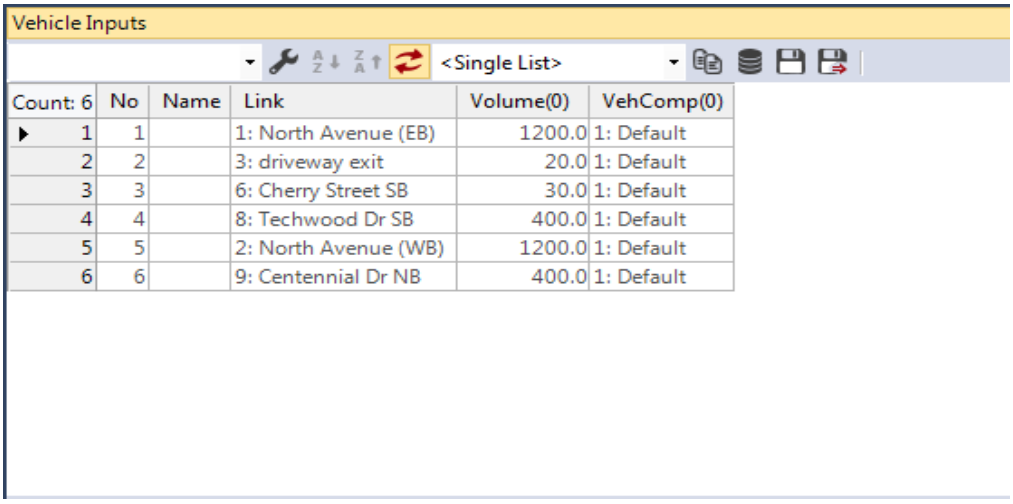



Figure 4.7 Vehicle composition

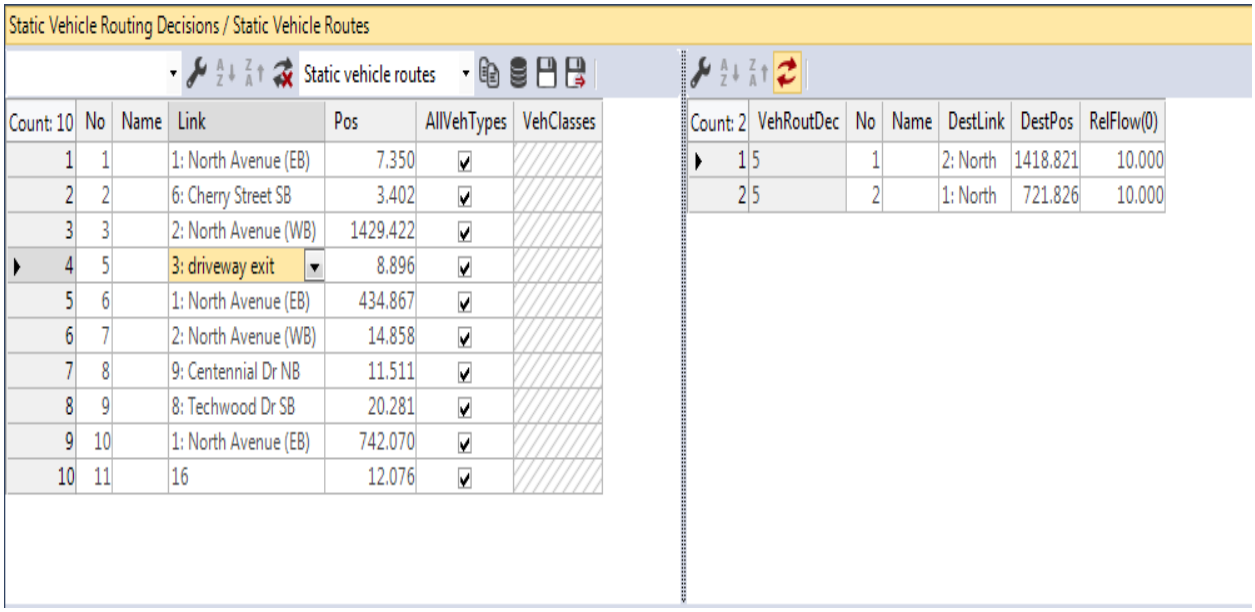
2. Enter the volumes in the vehicle inputs.




| Count: 6 | No | Name | Link | Volume(0) | VehComp(0) |
|---|---|---|---|---|---|
| 1 | 1 | | 1: North Avenue (EB) | 1200.0 | 1: Default |
| 2 | 2 | | 3: driveway exit | 20.0 | 1: Default |
| 3 | 3 | | 6: Cherry Street SB | 30.0 | 1: Default |
| 4 | 4 | | 8: Techwood Dr SB | 400.0 | 1: Default |
| 5 | 5 | | 2: North Avenue (WB) | 1200.0 | 1: Default |
| 6 | 6 | | 9: Centennial Dr NB | 400.0 | 1: Default |

Figure 4.8 Vehicle composition

3. Enter route decisions.




| Count: 10 | No | Name | Link | Pos | AllVehTypes | VehClasses |
|---|---|---|---|---|---|---|
| 1 | 1 | | 1: North Avenue (EB) | 7.350 | ☑ | |
| 2 | 2 | | 6: Cherry Street SB | 3.402 | ☑ | |
| 3 | 3 | | 2: North Avenue (WB) | 1429.422 | ☑ | |
| 4 | 5 | | 3: driveway exit | 8.896 | ☑ | |
| 5 | 6 | | 1: North Avenue (EB) | 434.867 | ☑ | |
| 6 | 7 | | 2: North Avenue (WB) | 14.858 | ☑ | |
| 7 | 8 | | 9: Centennial Dr NB | 11.511 | ☑ | |
| 8 | 9 | | 8: Techwood Dr SB | 20.281 | ☑ | |
| 9 | 10 | | 1: North Avenue (EB) | 742.070 | ☑ | |
| 10 | 11 | | 16 | 12.076 | ☑ | |

| Count: 2 | VehRoutDec | No | Name | DestLink | DestPos | RelFlow(0) |
|---|---|---|---|---|---|---|
| 1 | 5 | 1 | | 2: North | 1418.821 | 10.000 |
| 2 | 5 | 2 | | 1: North | 721.826 | 10.000 |

Figure 4.9Route Decisions

### 4.2.4 Add Controls:

1. Add stop control.


Figure 4.10 Add Stop Signs

2. Set conflict areas and add signal control.

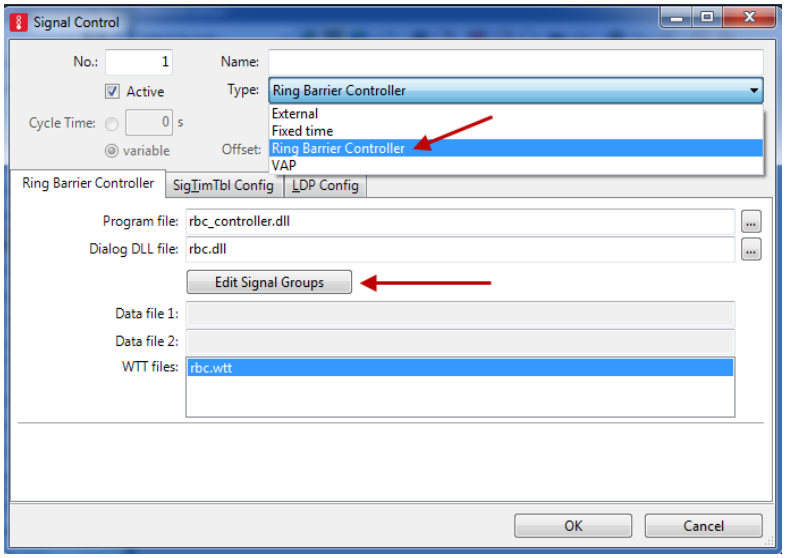



Figure 4.11 Add signal control

3. Complete the Basic portion of the **Ring Barrier Controller** window.

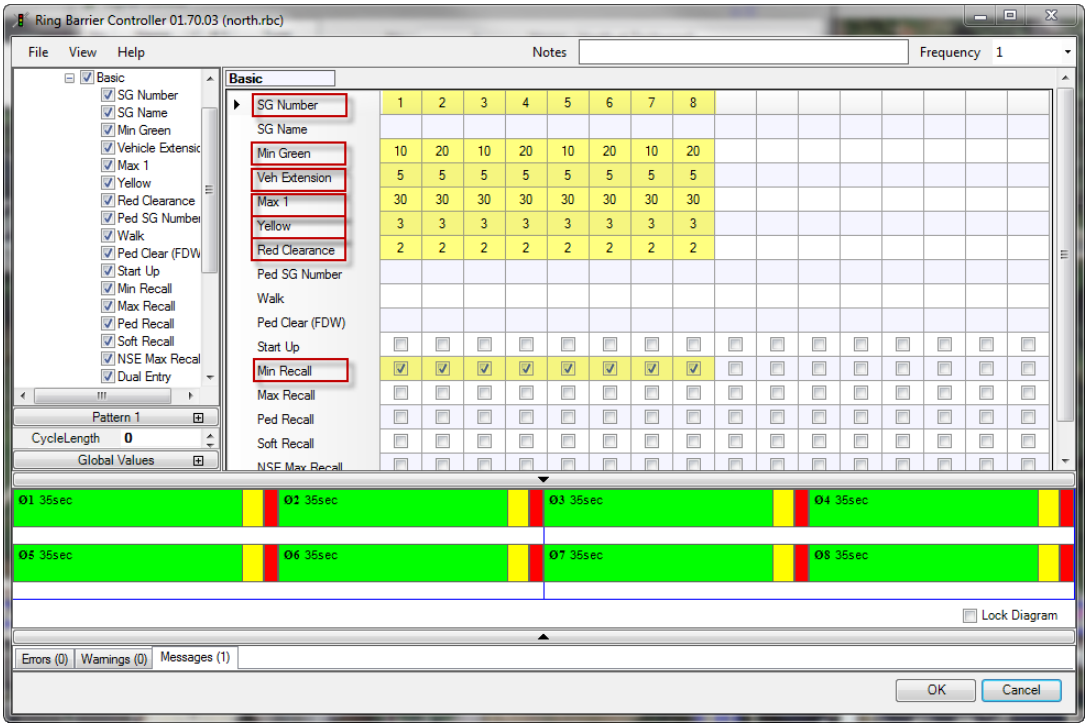



Figure 4.12 Add timing for signal control

4. Complete sequence portion of the **Ring Barrier Controller** window.

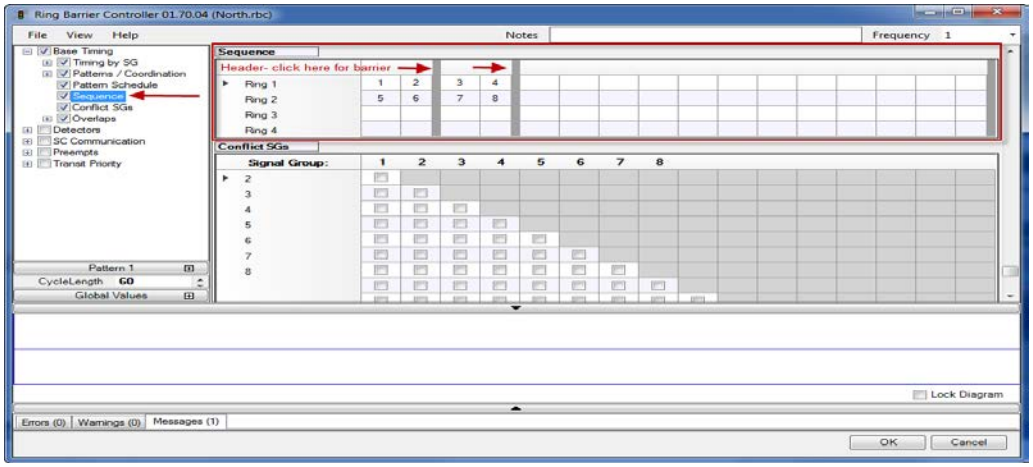



Figure 4.13 Add sequence for signal control

5. Place signal heads.

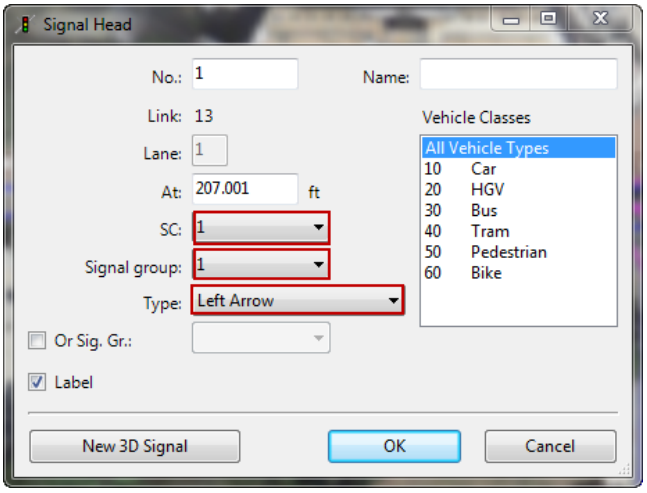



Figure 4.14 Add signal heads

6. Add detectors to RBC control.

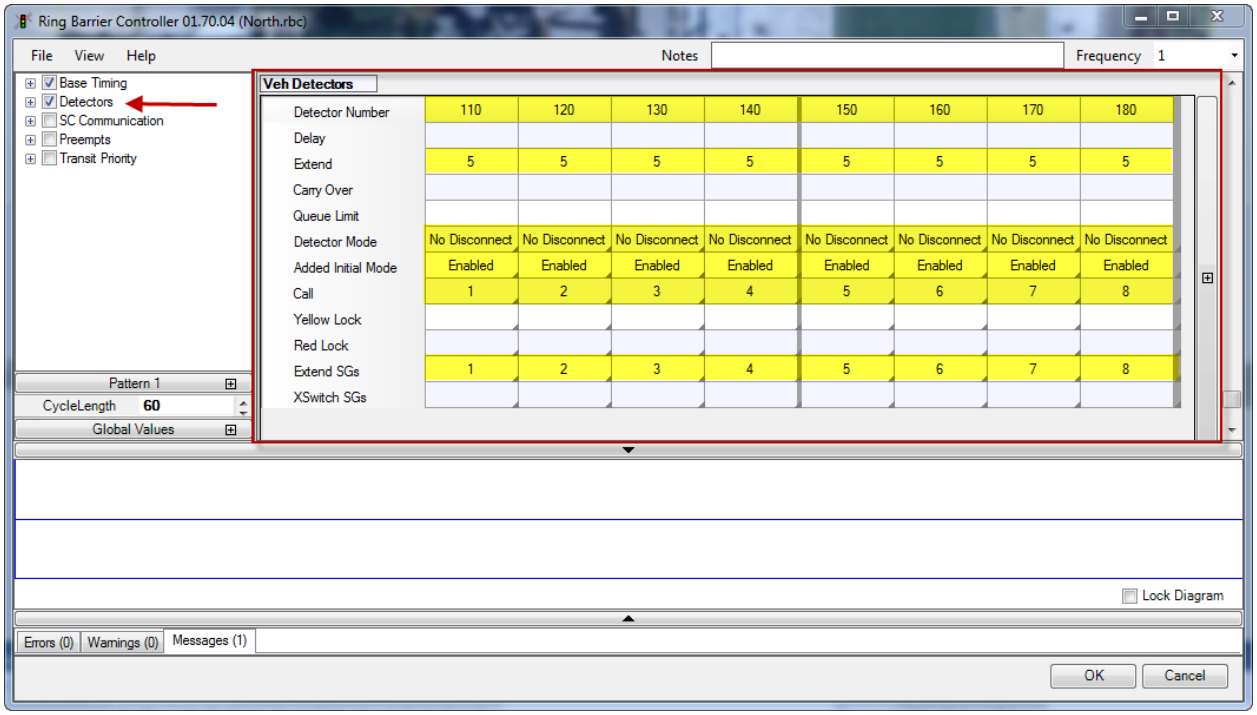



Figure 4.15 Add detectors

### 4.2.5Run Simulation:

1. Select **simulation** from menu bar and go to **parameters**.

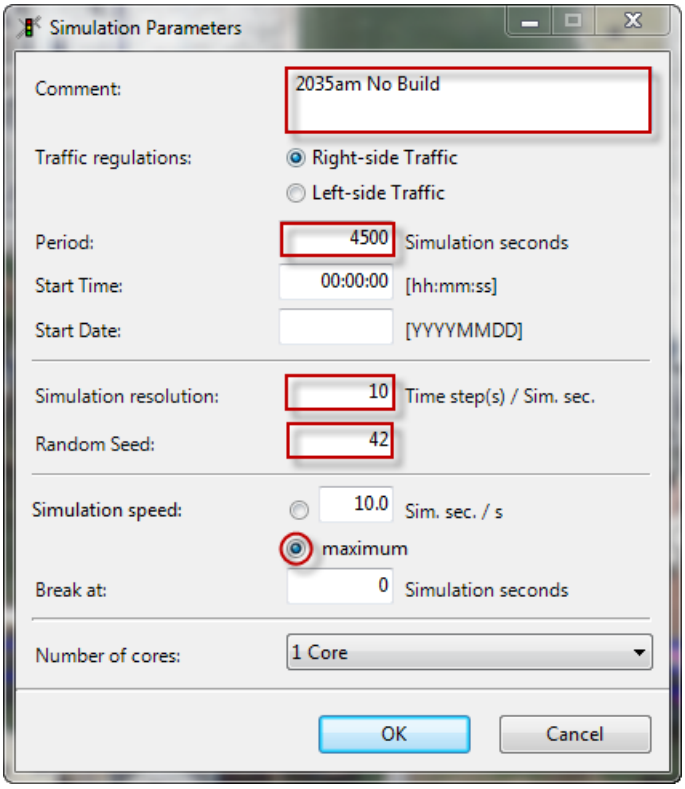



Figure 4.16 Add Simulations parameters

2. Run the simulation.

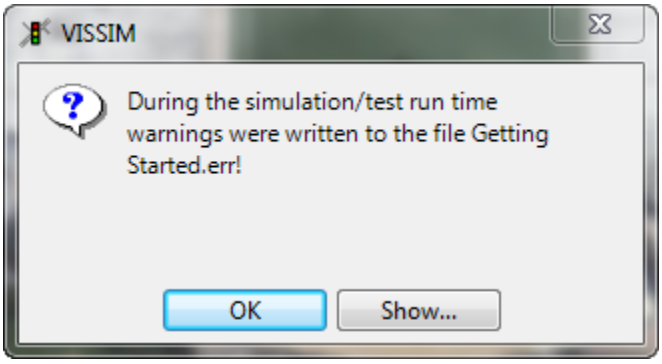



Figure 4.17 Run Simulations

### 4.2.6 Output Data:

1. Collect travel time and delay output data.

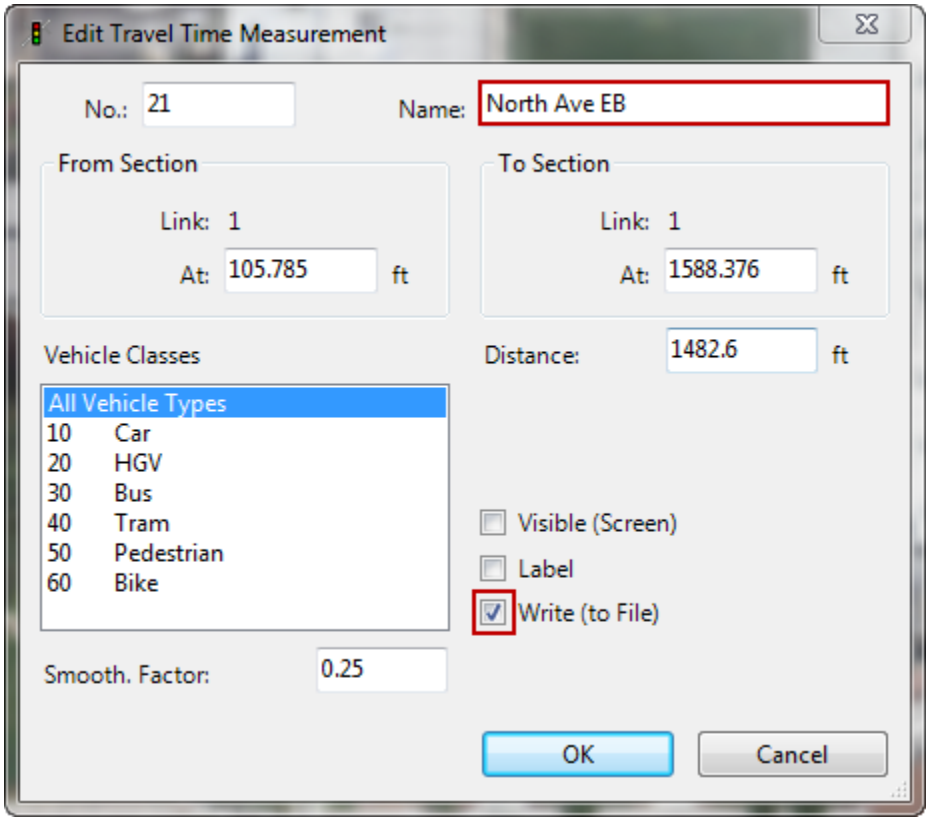



Figure 4.18 Output data

2. Configure travel time measurement.

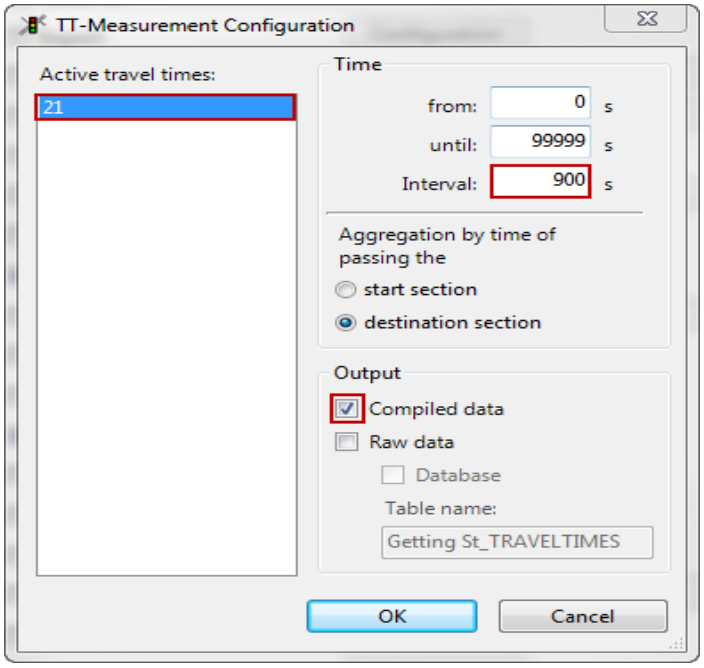



Figure 4.19 Output data parameters

3. Configure delay measurement.

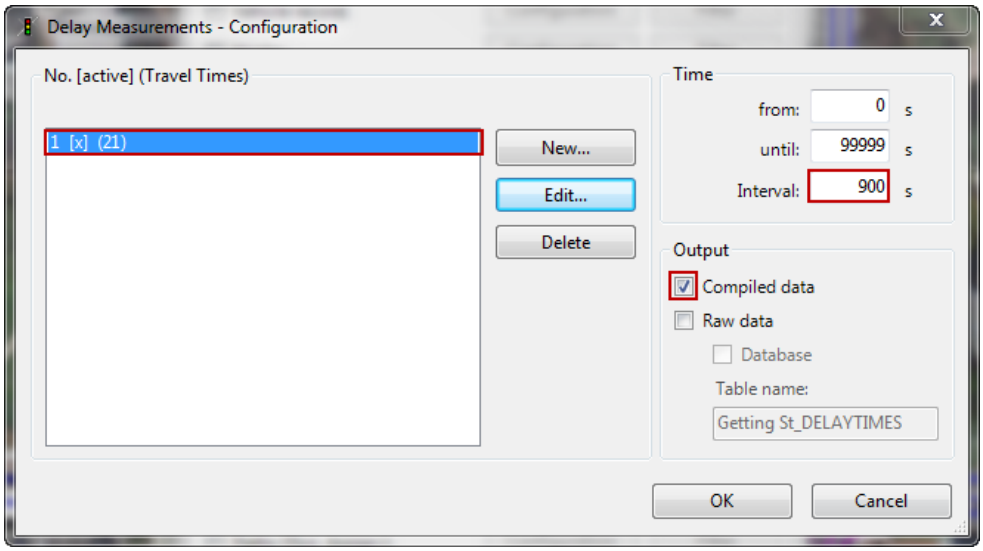



Figure 4.20 Output data interval setting

4. View travel time and delay output files.

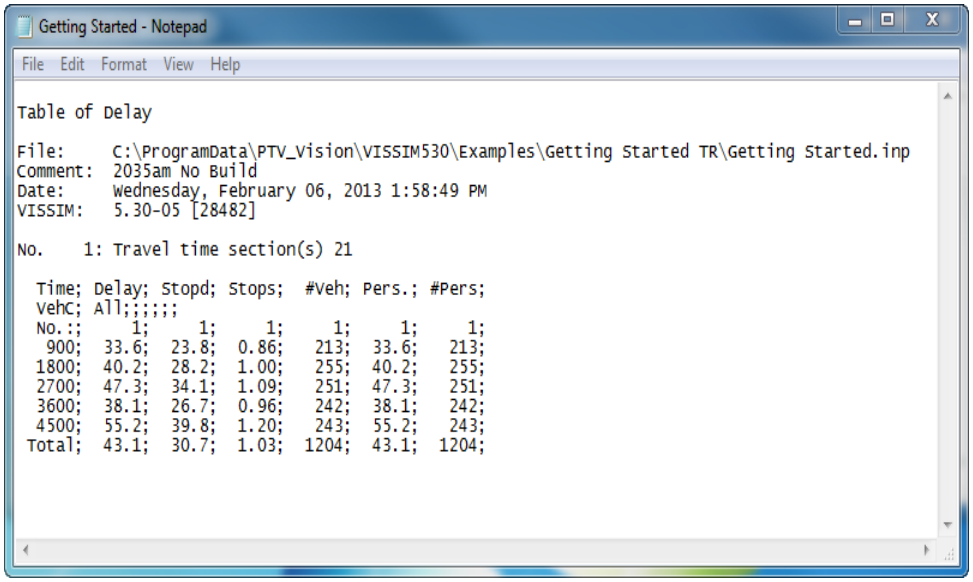



Figure 4.21 Output Data table

# RESULTSAND ANALYSIS

# CHAPTER - 5
# Results and Analysis

## 5.1 Introduction:

This section of the study predominantly highlights the estimation and valuation of the current LOS on the Kacheri intersection in Rawalpindi city. In order to ensure, Excel and VISSIM 9 was used for this purpose. Our research topic needed first-hand information so field observation was made including traffic counts, turning volumes and geometric conditions.

## 5.2 Traffic Volumes Counts:

Turning volume counts at Kacheri intersection were collected using Jamar counters and through Traffic Police Rawalpindi. This data was collected on Tuesday, Friday and Sunday from 7:00 am to 18:00 pm. The truck traffic and passenger cars traffic were recorded and included in VISSIM. The traffic volume data collected of intersection is attached as Annexure “A”.

## 5.3 Peak Hour Volumes:

Traffic counts were evaluated by using an excel program in order to identify the peak hour. Following results were originated:

a. Kacheri intersection’s peak hour of traffic on Tuesday morning was noted between 08:00 am to 09:00 am having total traffic volume of 7870 vehicles/hr.

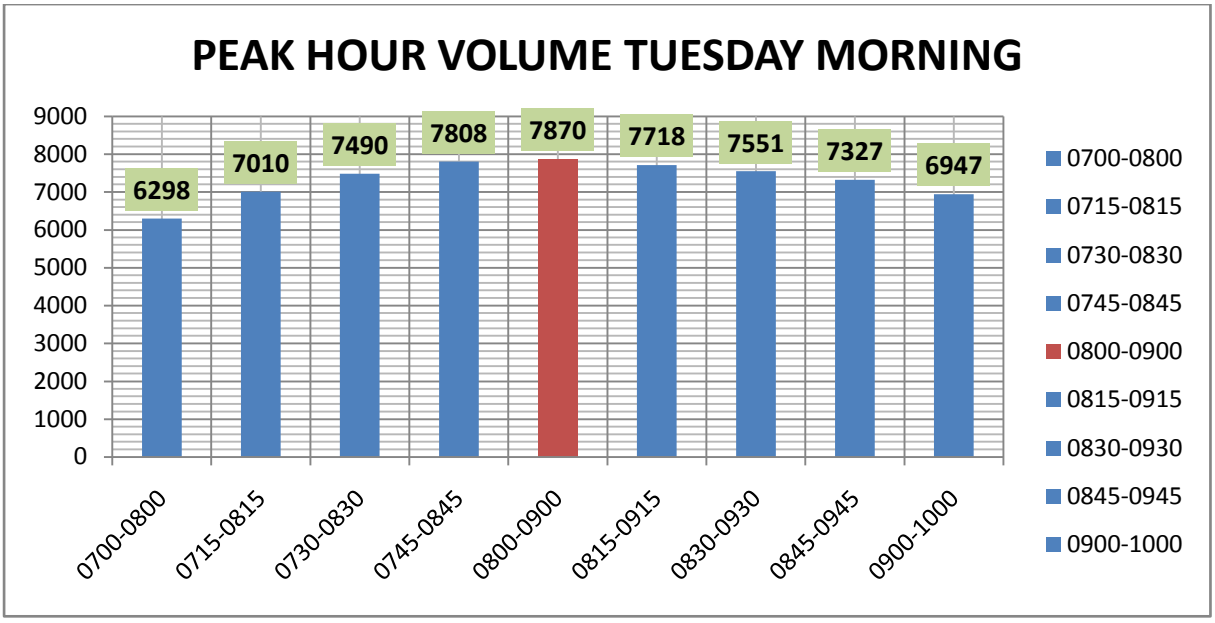



Figure 5.1 Peak Hour Volume at Kacheri intersection on Tuesday Morning

b. Kacheri intersection's peak hour of traffic on Tuesday Evening was noted between 04:30 pm to 05:30 pm having total traffic volume of 7502 vehs/hr.

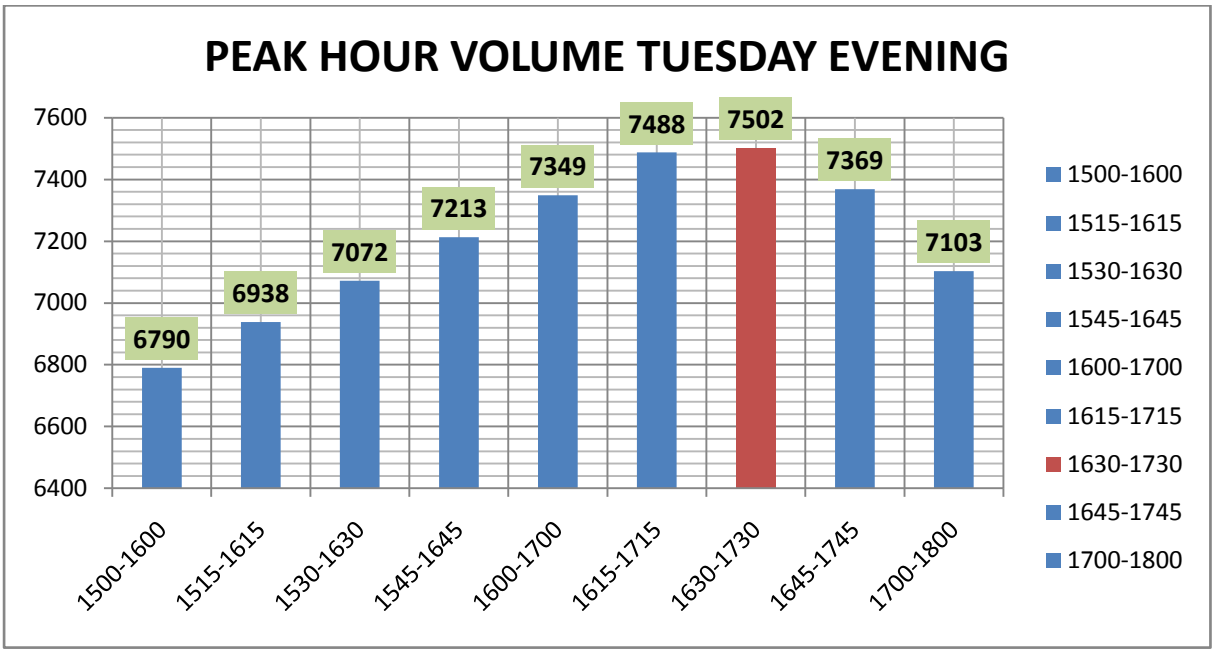



Figure 5.2 Peak hour volume at Kacheri intersection on Tuesday Evening

c. Kacheri intersection's peak hour of traffic on Friday morning was noted between 07:45 am to 08:45 am having total traffic volume of 9966 vehicles/hr.

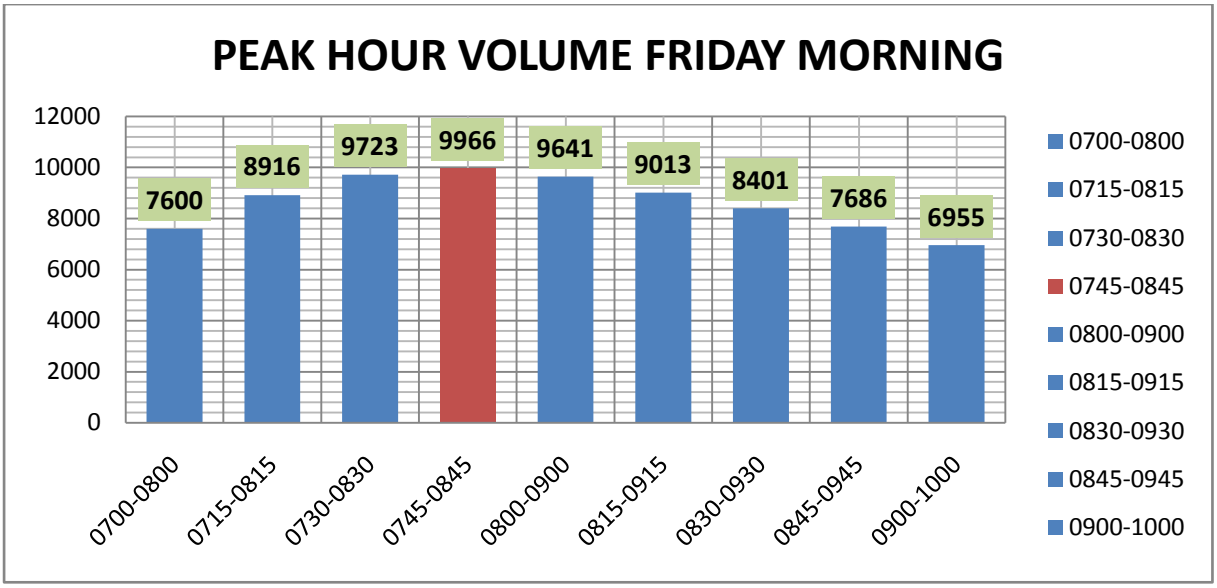



Figure 5.3 Peak hour volume at Kacheri intersection on Friday Morning

d. Kacheri intersection's peak hour of traffic on Friday Evening was noted between 12:30 pm to 01:30 pm having total traffic volume of 10415 vehicles/hr.

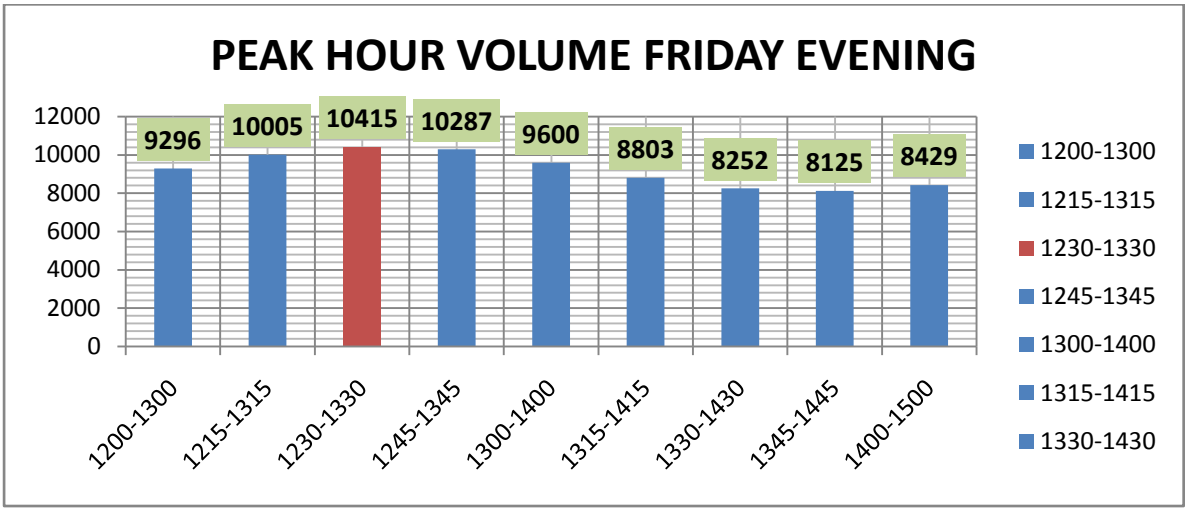



Figure 5.4 Peak hour volume at Kacheri intersection on Friday Evening

e. Kacheri intersection's peak hour of traffic on Sunday morning was noted between 10:15 am to 11:15 am having total traffic volume of 6703 vehicles/hr.

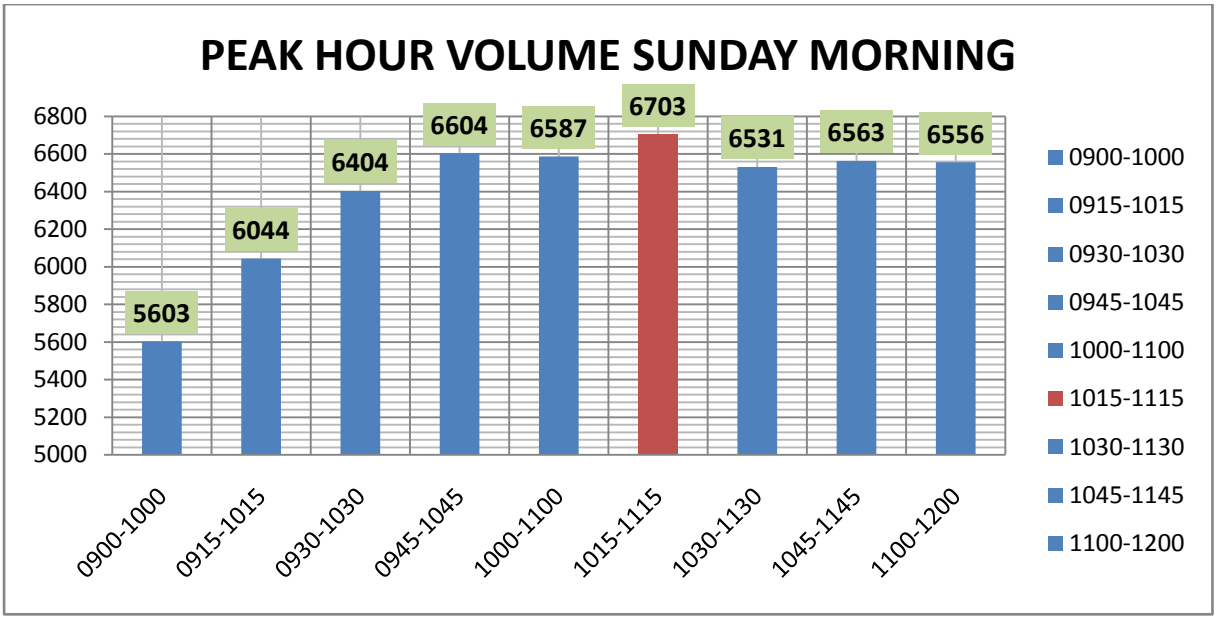



Figure 5.5 Peak hour volume at Kacheri intersection on Friday Morning

f. Kacheri intersection's peak hour of traffic on Sunday Evening was noted between 16:45 pm to 17:45 pm having total traffic volume of 9931 vehicles/hr.

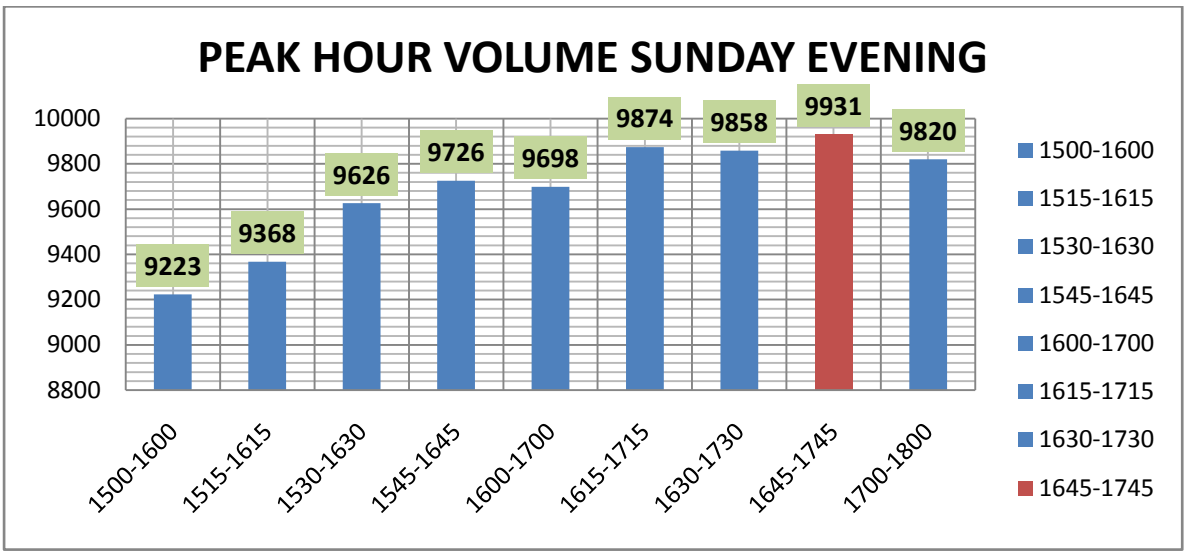



Figure 5.6 Peak hour volume at Kacheri intersection on Friday Evening

## 5.4 Peak Hour Factor:

The PHF is the ratio of total volume to the maximum 15-minute rate of flow within the hour. PHF was evaluated using an excel program. The PHF calculation is attached as Annexure "A" for all days. Table 5.4 below illustrates

the PHF for each turning movement for Kacheri intersection for Friday which had the maximum traffic volume.

| Approach | Movement | PHF |
|---|---|---|
| Towards Mareer Hassan | R | 0.932 |
| | TH | 0.934 |
| | L | 0.92 |
| Towards Lahore | R | 0.976 |
| | TH | 0.919 |
| | L | 0.912 |
| Towards Saddar | R | 0.918 |
| | TH | 0.946 |
| | L | 0.950 |
| Towards Airport | R | 0.923 |
| | TH | 0.951 |
| | L | 0.947 |

Table 5.1showing the PHF values for Kacheri intersection

## 5.5 Existing LOS:

PTV VISSIM 9 software was used to evaluate the current LOS of the intersection. The data which was gathered from the subject field was entered into the software. An analysis was done to find out the existing LOS of the four legged intersection. The LOS at Kacheri intersection is exhibited in table 5.5.

| Approach | Vehicle Delay (seconds) | Existing LOS |
|---|---|---|
| Towards MareerHasan | 87.45 | F |
| Towards Lahore | 141.45 | F |
| Towards Saddar | 134.45 | F |
| Towards Airport | 122.60 | F |

Table 5.2 showing the existing LOS at Kacheri intersection

## 5.6 Existing Queue Length:

PTV VISSIM 9 software was used to evaluate the queue length of the intersection. The data which was gathered from the subject field was entered into the software. An analysis was done to find out the queue length of four legged intersection. The data is shown below in table 5.6(a).

| Approach | Queue Length (ft) |
|---|---|
| Towards MareerHasan | 216.06 |
| Towards Lahore | 327.49 |
| Towards Saddar | 281.78 |
| Towards Airport | 249.66 |

Table 5.3 showing the Queue length at Kacheri intersection

## 5.7 Discussion on Results:

After compiling the results generated by PTV VISSIM 9 software, it is observed that the intersection is being operated below acceptable LOS i.e. LOS F therefore suggesting an intervention in the infrastructure to improve the efficiency of this intersection thereby improving overall traffic conditions in Rawalpindi city.

# PROPOSED DESIGN ALTERNATIVES

# Chapter – 6
# Proposed Design Alternatives

## 6.1 Introduction:

This chapter includes the proposed design alternatives to overcome the traffic congestion problems of Kacherichowk, Rawalpindi. The issue of heavy traffic congestion at the city may be addressed for short term by the provision of a underpass along with the roundabout. Moreover, for the long term and better Level of service, Multigrade interchange is recommended. In subsequent part of this chapter we have discussed the above two proposed alternatives

## 6.2 Proposed new Underpass with roundabout:

### 6.2.1 Design Parameters:

Following design parameters were set for the proposed options.

a. The Underpass should be provided for AIRPORT – SADDAR &LAHORE – SADDAR road because of more traffic volume.
b. There should be 2 lanes each for underpass which should be 12 ft wide.
c. The remaining traffic should use the roundabout.
d. It is to be designed for 70 kmph, as it is the permissible speed on highways passing through urban area.
e. The maximum grade should be 4%.

Figure 6.1 Underpass with Roundabout

### 6.2.2 Result through Simulations:

The existing traffic data was entered in PTV VISSIM 9 software for the proposed design. The analysis and results were generated which are as described.

#### 6.2.2.1 LOS and Time Delay:

The LOS at Kacheri intersection for the proposed underpass is shown in table 6.2(a) below.

| Approach | Vehicle Delay (seconds) | Existing LOS |
|---|---|---|
| Towards MareerHasan | 20.21 | C |
| Towards Lahore | 40.41 | D |
| Towards Saddar | 42.91 | D |
| Towards Airport | 34.62 | C |

Table 6.1 showing the existing LOS at Kacheri intersection

#### 6.2.2.2 Queue Length:

The Queue length at Kacheri intersection for the proposed underpass is shown in table 6.2(b) below.

| Approach | Queue Length (feet) |
|---|---|
| Towards MareerHasan | 0.00 |
| Towards Lahore | 37.62 |
| Towards Saddar | 44.46 |
| Towards Airport | 0.00 |

Table 6.2 showing the Queue Length at Kacheri intersection

### 6.2.3 Advantages:

a. It will be an economical solution.

b. It has reduced the traffic congestion.

c. The LOS has been improved from F to C and D.

d. The Queue Length has been reduced to 37 feet

### 6.2.4 Disadvantages:

a. It is a short term solution.

b. The traffic congestion will develop again after some period.

## 6.3 Proposed New Multigrade Interchange:

### 6.3.1 Design Parameters:

Following design parameters were set for the proposed options.

a. The overpass should be provided for SADDAR – LAHORE & AIRPORT – SADDAR road and Underpass should be provided for AIRPORT – SADDAR &MAREER – SADDAR road because of more traffic volume.

b. There should be 2 lanes each for overpass and underpass which should be 12 feet wide.

c. The remaining traffic should use the roundabout.

d. It is to be designed for 70 kmph, as it is the permissible speed on highways passing through urban area.

e. The maximum grade should be 4%.

Figure 6.2Multigrade Interchange

### 6.3.2 Result through Simulations:

The existing traffic data was entered in PTV VISSIM 9 software for the proposed design. The analysis and results were generated which are as follows:

#### 6.3.2.1 LOS and Time Delay:

The LOS at Kacheri intersection for the proposed Multigrade Interchange is shown in table 6.3(a) below.

| Approach | Vehicle Delay (seconds) | Existing LOS |
|---|---|---|
| Towards MareerHasan | 1.31 | A |
| Towards Lahore | 3.91 | A |
| Towards Saddar | 4.73 | A |
| Towards Airport | 2.66 | A |

Table 6.3 showing the existing LOS at Kacheri intersection

### 6.3.2.2 Queue Length:

The Queue length at Kacheri intersection for the proposed Multigrade interchange is shown in table 6.2(b) below.

| Approach | Queue Length (ft) |
|---|---|
| Towards MareerHasan | 0.00 |
| Towards Lahore | 0.00 |
| Towards Saddar | 0.00 |
| Towards Airport | 0.00 |

Table 6.4 showing the Queue Length at Kacheri intersection

### 6.3.3 Advantages:

a. It will be a long term solution and will cater for the future growth.

b. It has removed the traffic congestion.

c. The LOS has been improved from F to A.

d. There is no vehicle Queue.

### 6.3.4 Disadvantages:

a. It is relatively expensive.

b. It might require land acquisition which can be ascertained after working on the geometric and structural design.

# CONCLUSION& RECOMMENDATIONS

# Chapter – 7
# Conclusion& Recommendations

This research study was mainlyintended at investigating the performance evaluation of at-grade urban signalized intersection. The researchers analysed the performance of current conditions of the designated area and improved the prevailing conditions by using the VISSIM 9 software to make it more efficient and effective. This study not only facilitated the researchers in the elevation of at-grade urban signalized intersections of Pakistan but our current study also helped us outside the country. To enhance the current signalized intersection, it was very crucial and foremostto know the existing conditions and for this purpose, a field survey was undertaken to estimate the turning movement counts on our designated area. The research setting taken wasKacheriChowk urban signalized intersection which was an at-grade signalized intersection. The field data was carried out on three different days of a week. We chose Tuesday, Friday and Sunday because according to HCM (2000), these days include a week day when the traffic is maximum, a weekend and a holiday. Here we counted three hours of traffic and turning movements' data which is also the peak hour of that day. Once the data was gathered, we found out the peak hour of that day. So we had three peak hours (one for Tuesday, one for Friday and one for Sunday). The one which is maximum of these three is the peak hour of that week. Furthermore, the researchers found out the PHF. VISSIM 9 software was used for the analysis of results. This effective and efficient software not only rendered us the Time delay but also gave us authentic Queue length and Level of Service (LOS) of all approaches for entire intersection,that wereneeded for performance investigation of at-grade signalized intersection. Simultaneously this software

VISSIM was used to describe the MOEs of proposed design options. According to the findings of the current study, the researchers have come up with a very beneficial panacea which was multigrade interchange. Few conclusions are drawn:-

a. Kacheri intersection is causing serious traffic congestion which is revealed by the analysis of VISSIM 9. The current traffic is operating at LOS F.
b. The applications of traffic management strategies are already present in the existing conditions. Even after these strategies along with signal optimization, the traffic is operating at LOS F which demands infrastructure intervention measures.
c. Short term with less capital proposal i.e. at grade Roundabout with Underpass will improve the LOS from F to C but will again create congestion in the next coming years.
d. Long term proposal i.e. Multigrade interchange would require a substantial capital but will lead to a permanent solution yielding LOS A.

Following is recommended in this regard.

a. Structural and geometric design of proposed infrastructure intervention studies may be taken up as future final year project.
b. As the software is user friendly and has vast application, it can be introduced as a part of regular course in transportation II.

# References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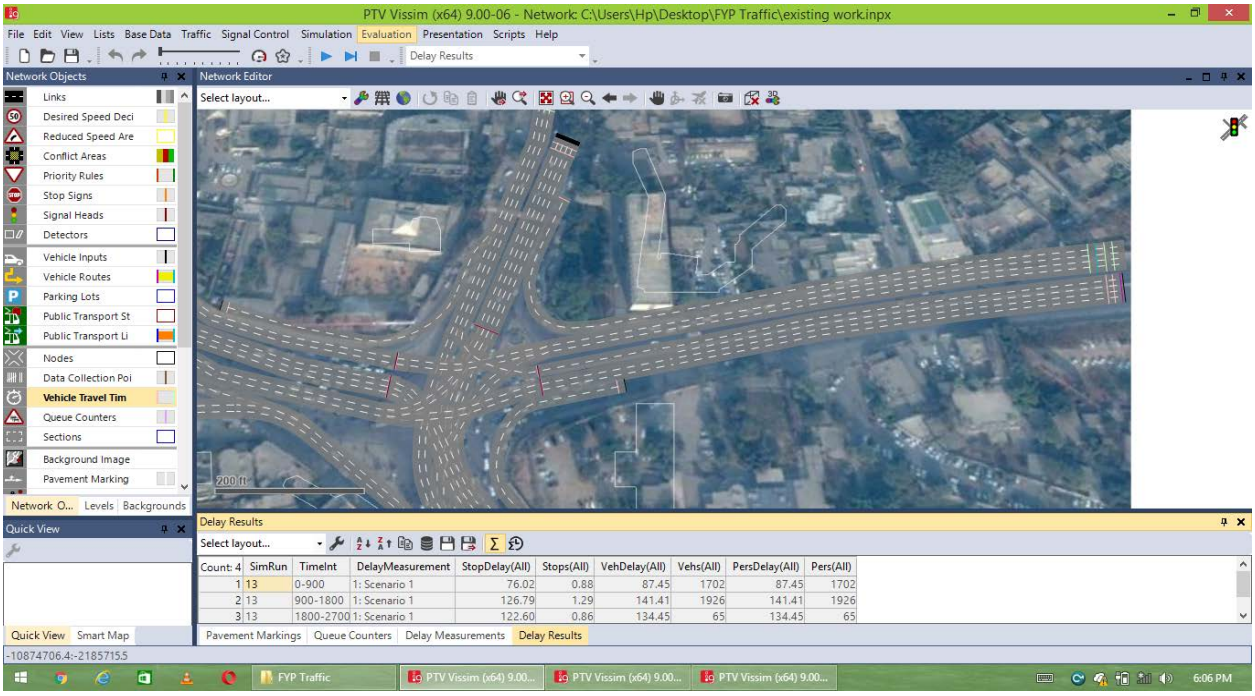
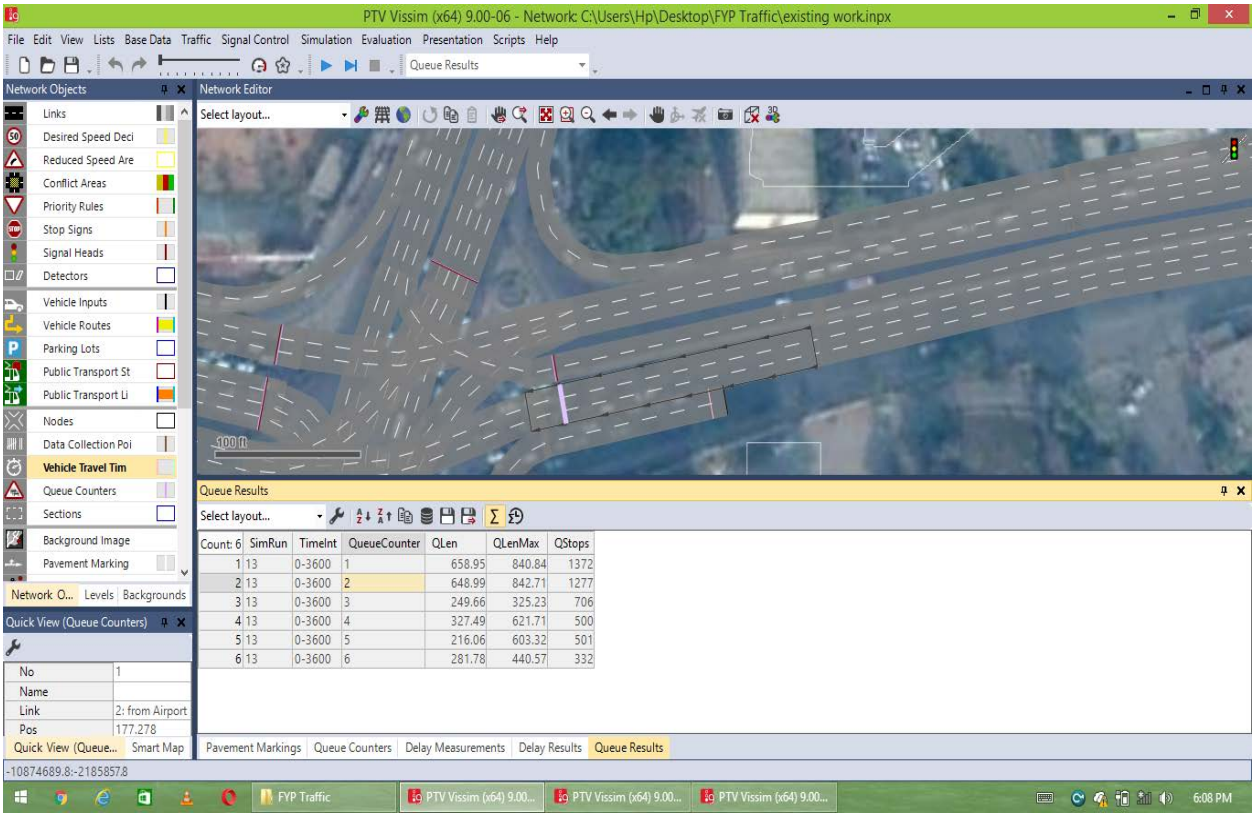
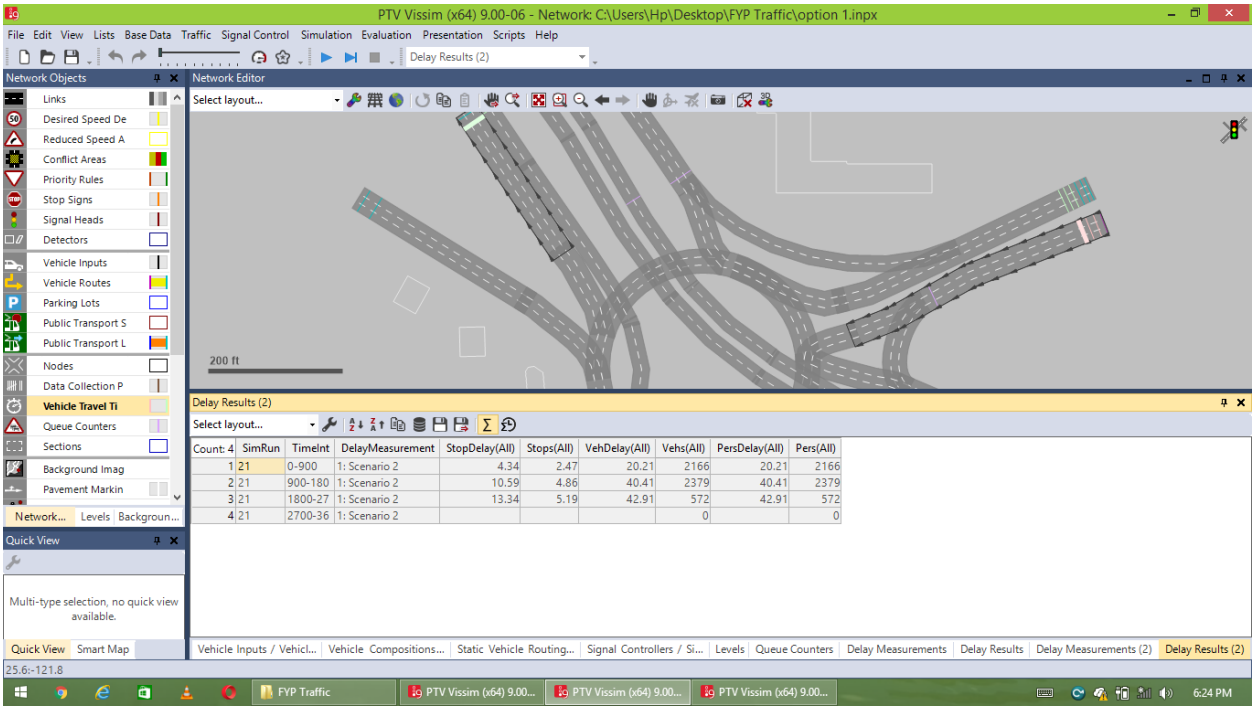
# APPENDICES

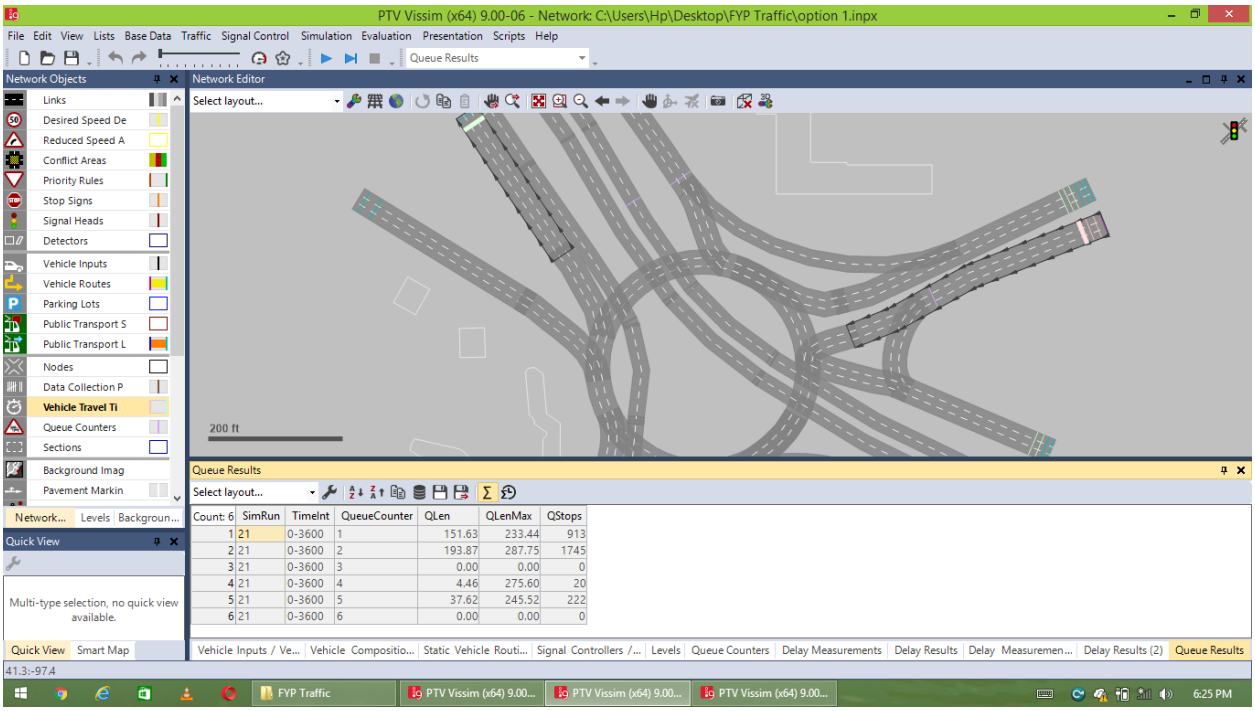
# APPENDIX B- RESULTS OF VISSIM FOR EXISTING CONDITIONS



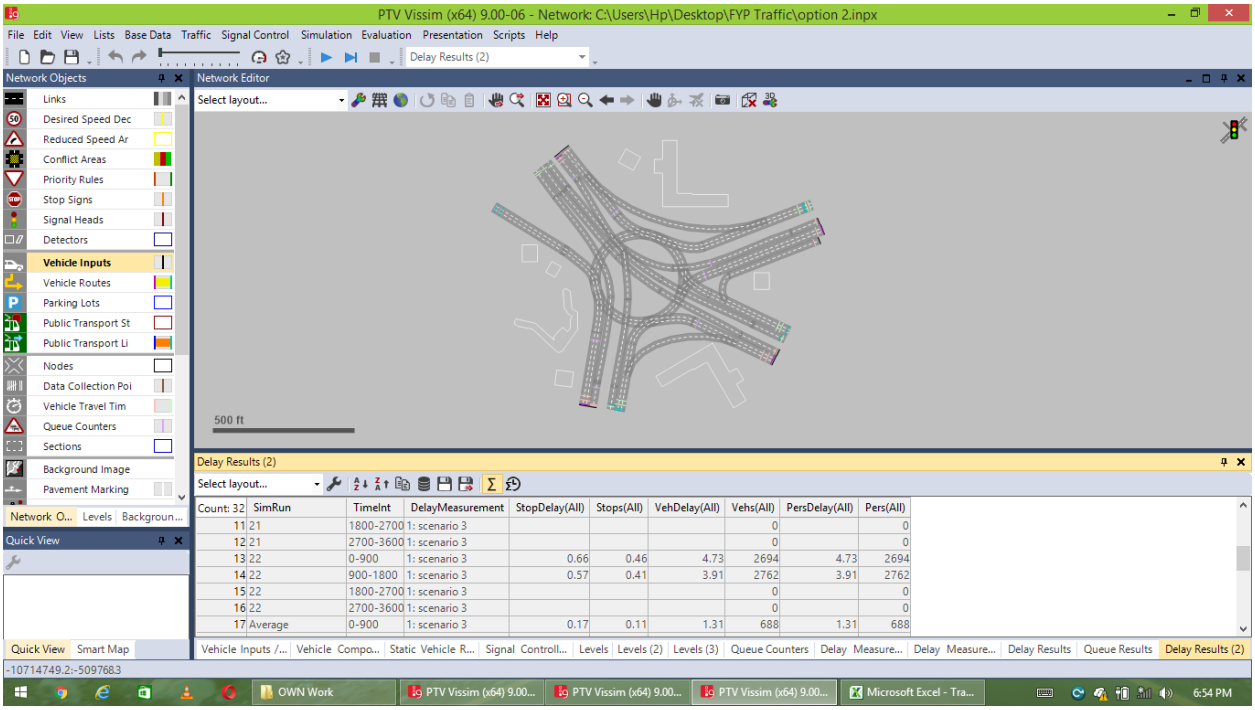



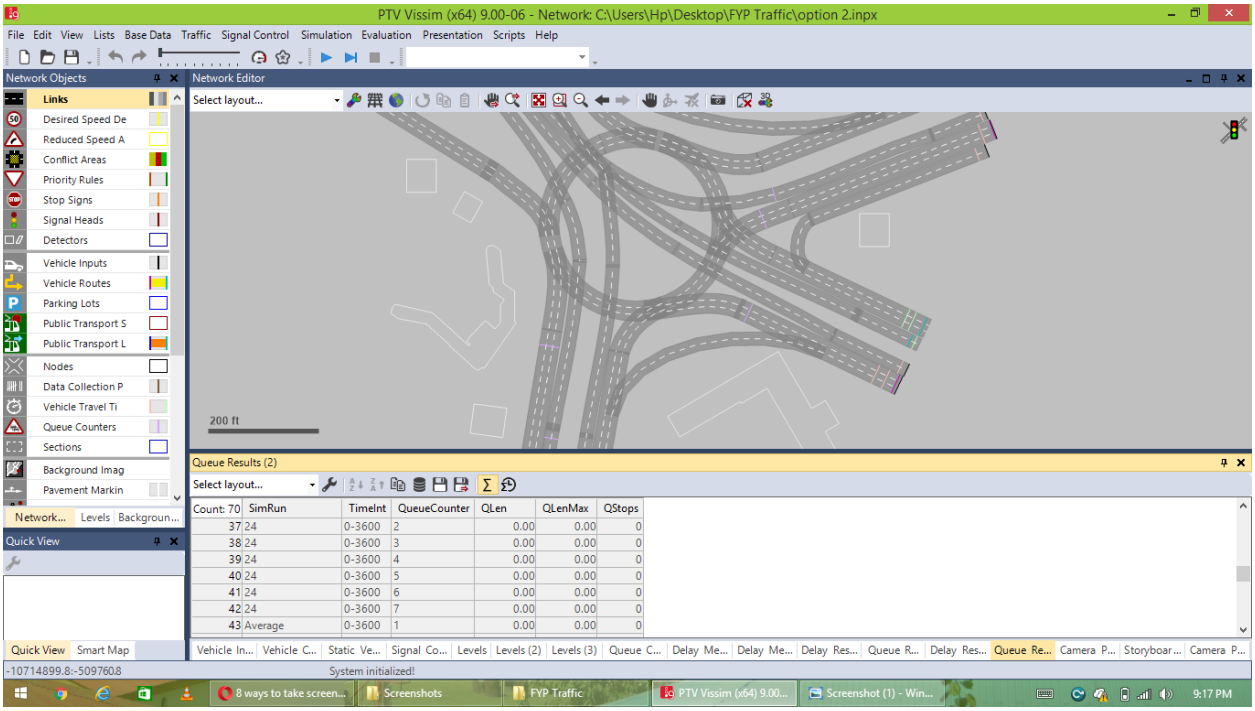
# APPENDIX C- RESULTS OF VISSIM FOR AT GRADE ROUNDABOUT WITH UNDERPASS



# APPENDIX D- RESULTS OF VISSIM FOR MULTIGRADE INTERCHANGE



## APPENDIX A- THREE HOURS MORNING AND EVENING TRAFFIC COUNT SURVEY AT KACHERI CHOWK, RAWALPINDI

Peak Hour Factor Friday Morning

| FRIDAY MORNING PEAK HOUR FACTOR | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Saddar)** | | | **East Bound (Towards Airport** | | | **Interval Total** |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | |
| 0745-0800 | 170 | 220 | 200 | 310 | 250 | 275 | 160 | 250 | 210 | 150 | 270 | 180 | **2645** |
| 0800-0815 | 165 | 210 | 205 | 290 | 220 | 255 | 160 | 260 | 200 | 160 | 256 | 160 | 2541 |
| 0815-0830 | 170 | 220 | 175 | 300 | 169 | 250 | 150 | 210 | 220 | 140 | 243 | 180 | 2427 |
| 0830-0845 | 160 | 215 | 186 | 287 | 145 | 240 | 145 | 200 | 190 | 190 | 235 | 160 | 2353 |
| TOTAL | 665 | 865 | 766 | 1187 | 784 | 1020 | 615 | 920 | 820 | 640 | 1004 | 680 | 9966 |
| PHF | 0.978 | 0.983 | 0.958 | 0.957 | 0.784 | 0.927 | 0.961 | 0.920 | 0.976 | 0.842 | 0.930 | 0.944 | 0.942 |
| | | | | | | | | | | | | | |

Friday Morning Peak Hour

| FRIDAY MORNING PEAK HOUR | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Saddar)** | | | **East Bound (Towards Airport)** | | | **Interval Total** |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | |
| 0700-0800 | 540 | 645 | 550 | 865 | 680 | 760 | 530 | 720 | 560 | 500 | 760 | 490 | **7600** |
| 0715-0815 | 615 | 750 | 680 | 1015 | 805 | 905 | 590 | 855 | 670 | 560 | 896 | 575 | 8916 |
| 0730-0830 | 655 | 830 | 740 | 1140 | 829 | 990 | 620 | 920 | 775 | 580 | 989 | 655 | 9723 |
| 0745-0845 | 665 | 865 | 766 | 1187 | 784 | 1020 | 615 | 920 | 820 | 640 | 1004 | 680 | 9966 |
| 0800-0900 | 655 | 855 | 746 | 1167 | 724 | 965 | 585 | 880 | 790 | 640 | 984 | 650 | 9641 |
| 0815-0915 | 625 | 825 | 691 | 1087 | 654 | 893 | 540 | 840 | 710 | 600 | 938 | 610 | 9013 |
| 0830-0930 | 555 | 780 | 656 | 987 | 625 | 803 | 500 | 780 | 650 | 600 | 885 | 580 | 8401 |
| 0845-0945 | 490 | 725 | 570 | 930 | 610 | 742 | 455 | 710 | 560 | 540 | 806 | 548 | 7686 |
| 0900-1000 | 420 | 635 | 505 | 800 | 520 | 772 | 415 | 625 | 500 | 515 | 736 | 512 | 6955 |

Peak Hour Factor Friday Evening

| FRIDAY EVENING PEAK HOU | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West (Towarc** | |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Thr** |
| 1230-1245 | 205 | 190 | 148 | 250 | 190 | 165 | 190 | |
| 1245-1300 | 225 | 200 | 160 | 289 | 205 | 170 | 214 | |
| 1300-1315 | 250 | 215 | 175 | 300 | 226 | 173 | 200 | |
| 1315-1330 | 240 | 190 | 170 | 256 | 210 | 168 | 210 | |
| TOTAL | 920 | 795 | 653 | 1095 | 831 | 676 | 814 | |
| PHF | 0.920 | 0.924 | 0.933 | 0.913 | 0.919 | 0.977 | 0.951 | ( |
| | | | | | | | | |

Friday Morning

| FRIDAY MORNING | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Saddar)** | | |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Rig** |
| 0700-0715 | 90 | 105 | 75 | 140 | 95 | 110 | 100 | 125 | |
| 0715-0730 | 130 | 140 | 115 | 175 | 145 | 165 | 120 | 145 | 1 |
| 0730-0745 | 150 | 180 | 160 | 240 | 190 | 210 | 150 | 200 | 1 |
| 0745-0800 | 170 | 220 | 200 | 310 | 250 | 275 | 160 | 250 | 2 |
| 0800-0815 | 165 | 210 | 205 | 290 | 220 | 255 | 160 | 260 | 2 |
| 0815-0830 | 170 | 220 | 175 | 300 | 169 | 250 | 150 | 210 | 2 |
| 0830-0845 | 160 | 215 | 186 | 287 | 145 | 240 | 145 | 200 | 1 |
| 0845-0900 | 160 | 210 | 180 | 290 | 190 | 220 | 130 | 210 | 1 |
| 0900-0915 | 135 | 180 | 150 | 210 | 150 | 183 | 115 | 220 | 1 |
| 0915-0930 | 100 | 175 | 140 | 200 | 140 | 160 | 110 | 150 | 1 |
| 0930-0945 | 95 | 160 | 100 | 230 | 130 | 179 | 100 | 130 | 1 |
| 0945-1000 | 90 | 120 | 115 | 160 | 100 | 250 | 90 | 125 | 1 |
| **Total** | **1615** | **2135** | **1801** | **2832** | **1924** | **2497** | **1530** | **2225** | **18** |

Friday Evening

| FRIDAY EVENING | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Saddar)** | | | **East Bound (Towards Airport)** | | | **Interval** |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | |
| 1200-1215 | 200 | 176 | 110 | 200 | 176 | 127 | 175 | 175 | 200 | 150 | 200 | 176 | **2065** |
| 1215-1230 | 210 | 182 | 139 | 220 | 145 | 141 | 180 | 189 | 219 | 160 | 230 | 195 | 2210 |
| 1230-1245 | 205 | 190 | 148 | 250 | 190 | 165 | 190 | 200 | 230 | 179 | 250 | 200 | 2397 |
| 1245-1300 | 225 | 200 | 160 | 289 | 205 | 170 | 214 | 215 | 262 | 195 | 275 | 214 | 2624 |
| 1300-1315 | 250 | 215 | 175 | 300 | 226 | 173 | 200 | 235 | 270 | 210 | 280 | 240 | 2774 |
| 1315-1330 | 240 | 190 | 170 | 256 | 210 | 168 | 210 | 240 | 230 | 212 | 261 | 233 | 2620 |
| 1330-1345 | 200 | 150 | 120 | 240 | 159 | 120 | 180 | 180 | 250 | 200 | 255 | 215 | 2269 |
| 1345-1400 | 150 | 125 | 110 | 168 | 178 | 110 | 135 | 155 | 210 | 196 | 200 | 200 | 1937 |
| 1400-1415 | 110 | 140 | 165 | 180 | 220 | 100 | 165 | 135 | 200 | 165 | 202 | 195 | 1977 |
| 1415-1430 | 150 | 170 | 140 | 200 | 200 | 130 | 170 | 159 | 220 | 146 | 231 | 153 | 2069 |
| 1430-1445 | 170 | 190 | 150 | 250 | 189 | 150 | 150 | 170 | 210 | 173 | 220 | 120 | 2142 |
| 1445-1500 | 120 | 195 | 140 | 240 | 176 | 165 | 180 | 195 | 236 | 191 | 243 | 160 | 2241 |
| **TOTAL** | **2230** | **2123** | **1727** | **2793** | **2274** | **1719** | **2149** | **2248** | **2737** | **2177** | **2847** | **2301** | **27325** |

Sunday Morning

| SUNDAY MORNING | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Saddar)** | | | **East Bound (Towards Airport)** | | | **Interval** |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | |
| 0900-0915 | 90 | 105 | 85 | 80 | 95 | 110 | 99 | 125 | 95 | 100 | 115 | 95 | **1194** |
| 0915-0930 | 95 | 115 | 110 | 115 | 108 | 120 | 120 | 145 | 115 | 118 | 109 | 110 | **1380** |
| 0930-0945 | 80 | 95 | 120 | 132 | 110 | 135 | 115 | 122 | 128 | 138 | 127 | 134 | **1436** |
| 0945-1000 | 120 | 135 | 105 | 110 | 119 | 144 | 125 | 160 | 143 | 156 | 130 | 146 | **1593** |
| 1000-1015 | 110 | 120 | 110 | 140 | 124 | 165 | 103 | 155 | 139 | 160 | 149 | 160 | 1635 |
| 1015-1030 | 125 | 160 | 125 | 150 | 110 | 180 | 120 | 170 | 135 | 169 | 145 | 151 | 1740 |
| 1030-1045 | 115 | 165 | 135 | 136 | 145 | 156 | 118 | 163 | 125 | 151 | 144 | 139 | 1692 |
| 1045-1100 | 104 | 135 | 110 | 123 | 130 | 163 | 130 | 142 | 142 | 143 | 128 | 126 | 1576 |
| 1100-1115 | 120 | 150 | 135 | 140 | 150 | 171 | 126 | 139 | 138 | 139 | 138 | 149 | 1695 |
| 1115-1130 | 130 | 169 | 100 | 121 | 123 | 155 | 110 | 165 | 136 | 128 | 132 | 155 | 1624 |
| 1130-1145 | 125 | 150 | 120 | 119 | 142 | 170 | 108 | 155 | 140 | 138 | 140 | 161 | 1668 |
| 1145-1200 | 132 | 145 | 115 | 135 | 116 | 145 | 120 | 135 | 122 | 131 | 139 | 134 | 1569 |
| **Total** | **1346** | **1644** | **1370** | **1501** | **1472** | **1814** | **1394** | **1776** | **1558** | **1671** | **1596** | **1660** | **18802** |

Peak Hour Factor Sunday Morning

| SUNDAY MORNING PEAK HOUR FACTOR | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Saddar)** | | | **East Bound (Towards Airport** | | | **Interval Total** |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | |
| 1015-1030 | 125 | 160 | 125 | 150 | 110 | 180 | 120 | 170 | 135 | 169 | 145 | 151 | 1740 |
| 1030-1045 | 115 | 165 | 135 | 136 | 145 | 156 | 118 | 163 | 125 | 151 | 144 | 139 | 1692 |
| 1045-1100 | 104 | 135 | 110 | 123 | 130 | 163 | 130 | 142 | 142 | 143 | 128 | 126 | 1576 |
| 1100-1115 | 120 | 150 | 135 | 140 | 150 | 171 | 126 | 139 | 138 | 139 | 138 | 149 | 1695 |
| TOTAL | 464 | 610 | 505 | 549 | 535 | 670 | 494 | 614 | 540 | 602 | 555 | 565 | 6703 |
| PHF | 0.928 | 0.953 | 0.935 | 0.915 | 0.892 | 0.931 | 0.950 | 0.903 | 0.951 | 0.891 | 0.957 | 0.935 | 0.963 |

Sunday Evening Peak Hour

| SUNDAY EVENING PEAK HOUR | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Saddar)** | | | **East Bound (Towards Airport)** | | | **Interval Total** |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | |
| 1500 - 1600 | 815 | 725 | 841 | 898 | 730 | 771 | 694 | 779 | 776 | 731 | 767 | 696 | **9223** |
| 1515 - 1615 | 800 | 729 | 863 | 898 | 780 | 751 | 688 | 809 | 818 | 743 | 766 | 723 | 9368 |
| 1530 - 1630 | 781 | 715 | 875 | 935 | 831 | 775 | 707 | 820 | 830 | 780 | 818 | 759 | 9626 |
| 1545 - 1645 | 786 | 698 | 892 | 945 | 810 | 780 | 721 | 795 | 847 | 796 | 839 | 771 | 9680 |
| 1600 - 1700 | 786 | 702 | 883 | 952 | 783 | 776 | 708 | 765 | 846 | 797 | 867 | 787 | 9652 |
| 1615 - 1715 | 821 | 712 | 903 | 992 | 777 | 796 | 729 | 770 | 856 | 818 | 919 | 781 | 9874 |
| 1630 - 1730 | 860 | 712 | 918 | 976 | 767 | 784 | 700 | 770 | 877 | 810 | 919 | 765 | 9858 |
| 1645 - 1745 | 840 | 742 | 918 | 991 | 808 | 778 | 675 | 810 | 872 | 810 | 934 | 753 | 9931 |
| 1700 - 1800 | 820 | 740 | 887 | 985 | 820 | 767 | 680 | 815 | 872 | 805 | 916 | 713 | 9820 |

Peak Hour Factor Tuesday Morning

| TUESDAY MORNING PEAK HOUR FACTOR | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Saddar)** | | | **East Bound (Towards Airport** | | | **Interval Total** |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | |
| 1645-1700 | 200 | 187 | 231 | 241 | 178 | 191 | 165 | 185 | 210 | 196 | 228 | 200 | 2412 |
| 1700-1715 | 220 | 190 | 240 | 260 | 220 | 200 | 190 | 210 | 230 | 210 | 250 | 190 | 2610 |
| 1715-1730 | 230 | 175 | 227 | 240 | 200 | 198 | 170 | 200 | 222 | 204 | 231 | 185 | 2482 |
| 1730-1745 | 190 | 190 | 220 | 250 | 210 | 189 | 150 | 215 | 210 | 200 | 225 | 178 | 2427 |
| TOTAL | 840 | 742 | 918 | 991 | 808 | 778 | 675 | 810 | 872 | 810 | 934 | 753 | 9931 |
| PHF | 0.913 | 0.976 | 0.956 | 0.953 | 0.918 | 0.982 | 0.993 | 0.942 | 0.982 | 0.993 | 0.934 | 0.941 | 0.951 |
| | | | | | | | | | | | | | |

Peak Hour Factor Tuesday Morning

| TUESDAY MORNING PEAK HC | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West (Towarc** | |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Thr** |
| 0800-0815 | 151 | 170 | 203 | 165 | 120 | 177 | 141 | |
| 0815-0830 | 165 | 152 | 175 | 120 | 156 | 162 | 136 | |
| 0830-0845 | 159 | 144 | 182 | 144 | 145 | 145 | 145 | |
| 0845-0900 | 143 | 147 | 180 | 188 | 166 | 159 | 139 | |
| TOTAL | 618 | 613 | 740 | 617 | 587 | 643 | 561 | |
| PHF | 0.936 | 0.901 | 0.911 | 0.935 | 0.884 | 0.908 | 0.995 | ( |
| | | | | | | | | |

Tuesday Morning Peak Hour

| TUESDAY MORNING PEAK HOUR | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | North Bound (Towards MareerHasan) | | | South Bound (Towards Lahore) | | | West Bound (Towards Saddar) | | | East Bound (Towards Airport) | | | Interval Total |
| | Left | Through | Right | Left | Through | Right | Left | Through | Right | Left | Through | Right | |
| 0700 - 0800 | 478 | 543 | 494 | 561 | 427 | 548 | 506 | 598 | 522 | 500 | 632 | 489 | 6298 |
| 0715 - 0815 | 516 | 600 | 609 | 593 | 452 | 624 | 540 | 663 | 625 | 560 | 677 | 551 | 7010 |
| 0730 - 0830 | 573 | 629 | 669 | 574 | 503 | 651 | 556 | 728 | 730 | 580 | 698 | 599 | 7490 |
| 0745 - 0845 | 620 | 631 | 725 | 578 | 540 | 652 | 557 | 762 | 790 | 640 | 696 | 617 | 7808 |
| 0800 - 0900 | 618 | 613 | 740 | 617 | 587 | 643 | 561 | 810 | 793 | 640 | 647 | 601 | 7870 |
| 0815 - 0915 | 606 | 605 | 700 | 631 | 601 | 632 | 544 | 805 | 758 | 600 | 658 | 592 | 7732 |
| 0830 - 0930 | 568 | 595 | 658 | 703 | 597 | 642 | 520 | 763 | 689 | 600 | 652 | 578 | 7565 |
| 0845 - 0945 | 542 | 589 | 597 | 743 | 590 | 676 | 508 | 706 | 640 | 540 | 643 | 553 | 7327 |
| 0900 - 1000 | 541 | 573 | 541 | 715 | 534 | 660 | 476 | 630 | 591 | 515 | 654 | 517 | 6947 |

Peak Hour Factor Tuesday Evening

| TUESDAY EVENING PEAK HO | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West (Towarc** | |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Thr** |
| 1630-1645 | 157 | 144 | 147 | 136 | 171 | 171 | 158 | |
| 1645-1700 | 165 | 154 | 154 | 170 | 178 | 163 | 163 | |
| 1700-1715 | 165 | 160 | 161 | 169 | 151 | 167 | 171 | |
| 1715-1730 | 158 | 175 | 168 | 145 | 149 | 151 | 162 | |
| Total | 645 | 633 | 630 | 620 | 649 | 652 | 654 | |
| PHF | 0.977 | 0.904 | 0.938 | 0.912 | 0.912 | 0.953 | 0.956 | ( |
| | | | | | | | | |

Peak Hour Volume Tuesday Evening

| PEAK HOUR VOLUME -TUESDAY EV | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bo (Towards S** | |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Throug** |
| 1500-1600 | 573 | 509 | 494 | 651 | 557 | 639 | 577 | 52 |
| 1515-1615 | 595 | 529 | 507 | 664 | 589 | 629 | 576 | 51 |
| 1530-1630 | 592 | 536 | 537 | 643 | 614 | 614 | 588 | 54 |
| 1545-1645 | 599 | 558 | 555 | 605 | 641 | 628 | 597 | 58 |
| 1600-1700 | 599 | 573 | 572 | 610 | 670 | 623 | 609 | 63 |
| 1615-1715 | 622 | 592 | 602 | 616 | 663 | 639 | 646 | 66 |
| 1630-1730 | 645 | 633 | 630 | 620 | 649 | 652 | 654 | 67 |
| 1645-1745 | 625 | 650 | 634 | 635 | 619 | 625 | 651 | 66 |
| 1700-1800 | 591 | 640 | 618 | 631 | 573 | 592 | 625 | 63 |

Sunday Morning Peak Hour

| SUNDAY MORNING PEAK HOUR | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Saddar)** | | | **East Bound (Towards Airport)** | | | **Interval Total** |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | |
| 0900-1000 | 385 | 450 | 420 | 437 | 432 | 509 | 459 | 552 | 481 | 512 | 481 | 485 | **5603** |
| 0915-1015 | 405 | 465 | 445 | 497 | 461 | 564 | 463 | 582 | 525 | 572 | 515 | 550 | 6044 |
| 0930-1030 | 435 | 510 | 460 | 532 | 463 | 624 | 463 | 607 | 545 | 623 | 551 | 591 | 6404 |
| 0945-1045 | 470 | 580 | 475 | 536 | 498 | 645 | 466 | 648 | 542 | 636 | 568 | 596 | 6660 |
| 1000-1100 | 454 | 580 | 480 | 549 | 509 | 664 | 471 | 630 | 541 | 623 | 566 | 576 | 6643 |
| 1015-1115 | 464 | 610 | 505 | 549 | 535 | 670 | 494 | 614 | 540 | 602 | 555 | 565 | 6703 |
| 1030-1130 | 469 | 619 | 480 | 520 | 548 | 645 | 484 | 609 | 541 | 561 | 542 | 569 | 6587 |
| 1045-1145 | 479 | 604 | 465 | 503 | 545 | 659 | 474 | 601 | 556 | 548 | 538 | 591 | 6563 |
| 1100-1200 | 507 | 614 | 470 | 515 | 531 | 641 | 464 | 594 | 536 | 536 | 549 | 599 | 6556 |

Tuesday Evening

| TUESDAY EVENING | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Sadd** | | |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | |
| 1500-1515 | 120 | 121 | 118 | 150 | 126 | 161 | 135 | 144 | |
| 1515-1530 | 138 | 127 | 110 | 162 | 138 | 153 | 142 | 131 | |
| 1530-1545 | 150 | 122 | 129 | 174 | 144 | 157 | 149 | 128 | |
| 1545-1600 | 165 | 139 | 137 | 165 | 149 | 168 | 151 | 121 | |
| 1600-1615 | 142 | 141 | 131 | 163 | 158 | 151 | 134 | 139 | |
| 1615-1630 | 135 | 134 | 140 | 141 | 163 | 138 | 154 | 156 | |
| 1630-1645 | 157 | 144 | 147 | 136 | 171 | 171 | 158 | 165 | |
| 1645-1700 | 165 | 154 | 154 | 170 | 178 | 163 | 163 | 172 | |
| 1700-1715 | 165 | 160 | 161 | 169 | 151 | 167 | 171 | 171 | |
| 1715-1730 | 158 | 175 | 168 | 145 | 149 | 151 | 162 | 164 | |
| 1730-1745 | 137 | 161 | 151 | 151 | 141 | 144 | 155 | 155 | |
| 1745-1800 | 131 | 144 | 138 | 166 | 132 | 130 | 137 | 149 | |

Sunday Evening

| SUNDAY EVENING | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Saddar)** | | | **East Bound (Towards Airport)** | | | **Interval** |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | |
| 1500-1515 | 200 | 176 | 198 | 220 | 176 | 200 | 175 | 175 | 178 | 177 | 199 | 169 | **2243** |
| 1515-1530 | 210 | 189 | 200 | 219 | 159 | 186 | 180 | 189 | 189 | 175 | 179 | 165 | 2240 |
| 1530-1545 | 205 | 177 | 203 | 225 | 190 | 190 | 161 | 200 | 198 | 184 | 189 | 178 | 2300 |
| 1545-1600 | 200 | 183 | 240 | 234 | 205 | 195 | 178 | 215 | 211 | 195 | 200 | 184 | 2440 |
| 1600-1615 | 185 | 180 | 220 | 220 | 226 | 180 | 169 | 205 | 220 | 189 | 198 | 196 | 2388 |
| 1615-1630 | 191 | 175 | 212 | 256 | 210 | 210 | 199 | 200 | 201 | 212 | 231 | 201 | 2498 |
| 1630-1645 | 210 | 160 | 220 | 235 | 169 | 195 | 175 | 175 | 215 | 200 | 210 | 190 | 2354 |
| 1645-1700 | 200 | 187 | 231 | 241 | 178 | 191 | 165 | 185 | 210 | 196 | 228 | 200 | 2412 |
| 1700-1715 | 220 | 190 | 240 | 260 | 220 | 200 | 190 | 210 | 230 | 210 | 250 | 190 | 2610 |
| 1715-1730 | 230 | 175 | 227 | 240 | 200 | 198 | 170 | 200 | 222 | 204 | 231 | 185 | 2482 |
| 1730-1745 | 190 | 190 | 220 | 250 | 210 | 189 | 150 | 215 | 210 | 200 | 225 | 178 | 2427 |
| 1745-1800 | 180 | 185 | 200 | 235 | 190 | 180 | 170 | 190 | 210 | 191 | 210 | 160 | 2301 |
| **TOTAL** | **2421** | **2167** | **261** | **2835** | **2333** | **231** | **2082** | **2359** | **243** | **2333** | **2550** | **213** | **28695** |

Tuesday Morning

| TUESDAY MORNING | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Time** | **North Bound (Towards MareerHasan)** | | | **South Bound (Towards Lahore)** | | | **West Bound (Towards Saddar)** | | | **Eas (Towa** | |
| | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Through** | **Right** | **Left** | **Th** |
| 0700-0715 | 113 | 113 | 88 | 133 | 95 | 101 | 107 | 125 | 97 | 100 | |
| 0715-0730 | 108 | 123 | 115 | 139 | 105 | 135 | 120 | 145 | 115 | 120 | |
| 0730-0745 | 112 | 142 | 126 | 140 | 108 | 144 | 144 | 166 | 133 | 130 | |
| 0745-0800 | 145 | 165 | 165 | 149 | 119 | 168 | 135 | 162 | 177 | 150 | |
| 0800-0815 | 151 | 170 | 203 | 165 | 120 | 177 | 141 | 190 | 200 | 160 | |
| 0815-0830 | 165 | 152 | 175 | 120 | 156 | 162 | 136 | 210 | 220 | 140 | |
| 0830-0845 | 159 | 144 | 182 | 144 | 145 | 145 | 145 | 200 | 193 | 190 | |
| 0845-0900 | 143 | 147 | 180 | 188 | 166 | 159 | 139 | 210 | 180 | 150 | |
| 0900-0915 | 139 | 162 | 163 | 179 | 134 | 166 | 124 | 185 | 165 | 120 | |
| 0915-0930 | 127 | 142 | 133 | 192 | 152 | 172 | 112 | 168 | 151 | 140 | |
| 0930-0945 | 133 | 138 | 121 | 184 | 138 | 179 | 133 | 143 | 144 | 130 | |
| 0945-1000 | 142 | 131 | 124 | 160 | 110 | 143 | 107 | 134 | 131 | 125 | |
| **Total** | **1637** | **1729** | **1775** | **1893** | **1548** | **1851** | **1543** | **2038** | **1906** | **1655** | |