OPTIMIZATION OF PWD INTERSECTION AT ISLAMABAD HIGHWAY USING PTV VISSIM

FINAL YEAR PROJECT UG 2014

BY

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(2018)

This is to certify that the

Final Year Project Titled

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has been accepted towards the requirements
for the undergraduate degree

in

CIVIL ENGINEERING

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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 PWD Intersection in Rawalpindi because of its close proximity to private and commercial activities and housing societies.

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 PWD Intersection 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 PWD Intersection by assessing different options to improve the traffic capacity.

During the project, all the requisite data was collected manually. Few types of software 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.

DEDICATION

We would like to dedicate this project to our parents, teachers and friends. It is only through their consistent and unwavering support that we have been able to come this far not only in our academics but also as responsible members of the society.

DECLARATION

It is hereby solemnly and sincerely declared that the work referred to this thesis project has not been used by any other university or institute of learning as part of another qualification or degree. The research carried out and dissertation prepared was consistent with normal supervisory practice and all the external sources of information used have been acknowledged.

ACKNOWLEDGEMENTS

"In the name of Almighty Allah, the Most Beneficent, the Most Merciful"

We are very grateful to Allah Almighty, for providing us strength, perseverance, self-denial, hard work, and the patient to successfully complete this project.

We would like to thank Lec. Kamran Shakir for his guidance and supervision during the project. As our advisor, Lec. Kamran Shakir helped us a lot to manage our things. We are very grateful to him, and consider ourselves lucky to have worked under his professional supervision.

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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 numerous effects 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.
3. Vehicles parked at no parking zones thereby causing traffic flow interruptions.

4. Non-regulated intersections.
5. Vehicle failures or accidents.
6. Several motorists trying to use the same flow path simultaneously.
7. 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

We analyzed the effect of construction of a underpass on the portion of intersection joining Islamabad Express Highway to PWD. The primary cause for this traffic congestion is the remarkable difference between demand and capacity and existence of a network of several housing societies 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 and residential hub.

Critical time was observed to be during 07:00 to 09:00 a.m. and 5:00 p.m. to about 7:00 p.m. on week days and weekends. The reason for this hold up is the closing time of offices on weekdays. Another reason is the location of business centers in the close vicinity of PWD Intersection, which affected the geometry of some nodes extraordinarily.

We have attempted to investigate the traffic flow conditions at these intersections (Manually along with getting data from TRAFFIC POLICE and on software VISSIM 10.0) 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:-

1. Familiarization with the conduct of traffic survey at signalized and un-signalized intersections in urban areas.
2. Introduction and basic know how of software VISSIM 10.0 which simulates actual traffic flow conditions and analyze an intersection or network of intersections.
3. To learn how to study an intersection using Highway capacity manual.
4. 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:-

1. Traffic counts.
2. Vehicle delays.
3. Signal timings.
4. 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 10 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.

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:

1. Number of vehicles exceeding the design capacity.
2. Blockade on the roadway.
3. Inadequate intersection cycle length.
4. Traffic signal malfunction.
5. Excessive pedestrian crossing.

6. 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.

2.4 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).

2.5 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.

2.6 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 ($d1 \equiv du$),

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.

2.7 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.

2.8 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.

2.9 Classification of intersections:

Intersections are classified depending upon the treatment of crossing conflicts i.e.

a. At Grade Intersection

b. Grade Separated Intersection.

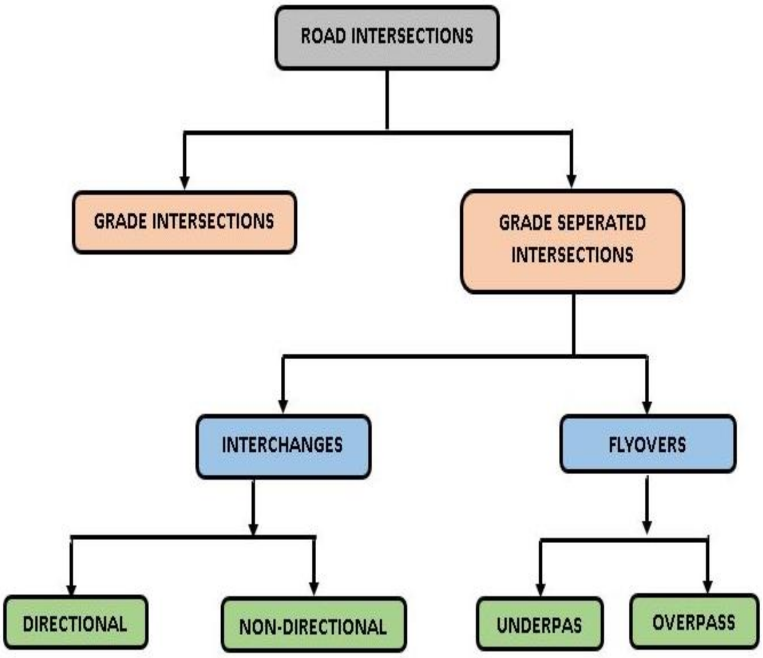


Figure 1 Flowchart showing classification of intersections

2.10 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. In grade separated intersections there are different possibilities that can be applied to reduce the congestion. Traffic engineers are adopting different methods for grade separation.

It may be a bridge that eliminates conflicts at intersections by vertical separation of roadways in space. Ramps are provided at grade intersection to separate the traffic. Interchange is designed in such a way that they can accommodate the traffic economically along with the physical requirements of the topography, adjoining land use, right-of-way and direction of movements.

The ultimate objective of the grade separated intersection is to eliminate the crossing conflicts and accommodate the merging and diverging traffic through weaving sections at low speed. Two types of interchanges are present one, in which ramps tends to follow the natural direction of movement called Directional Interchanges other is Non Directional Interchange in which there is a change in the natural path of traffic flow. Some of the grade separated intersections are as follows:

- Underpass
- Overpass
- Trumpet Interchange
- Diamond Interchange
- Cloverleaf Interchange
- Partial Cloverleaf Interchange

2.10.1Underpass:

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.

Figure 2Image showing an Underpass

2.10.2 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.

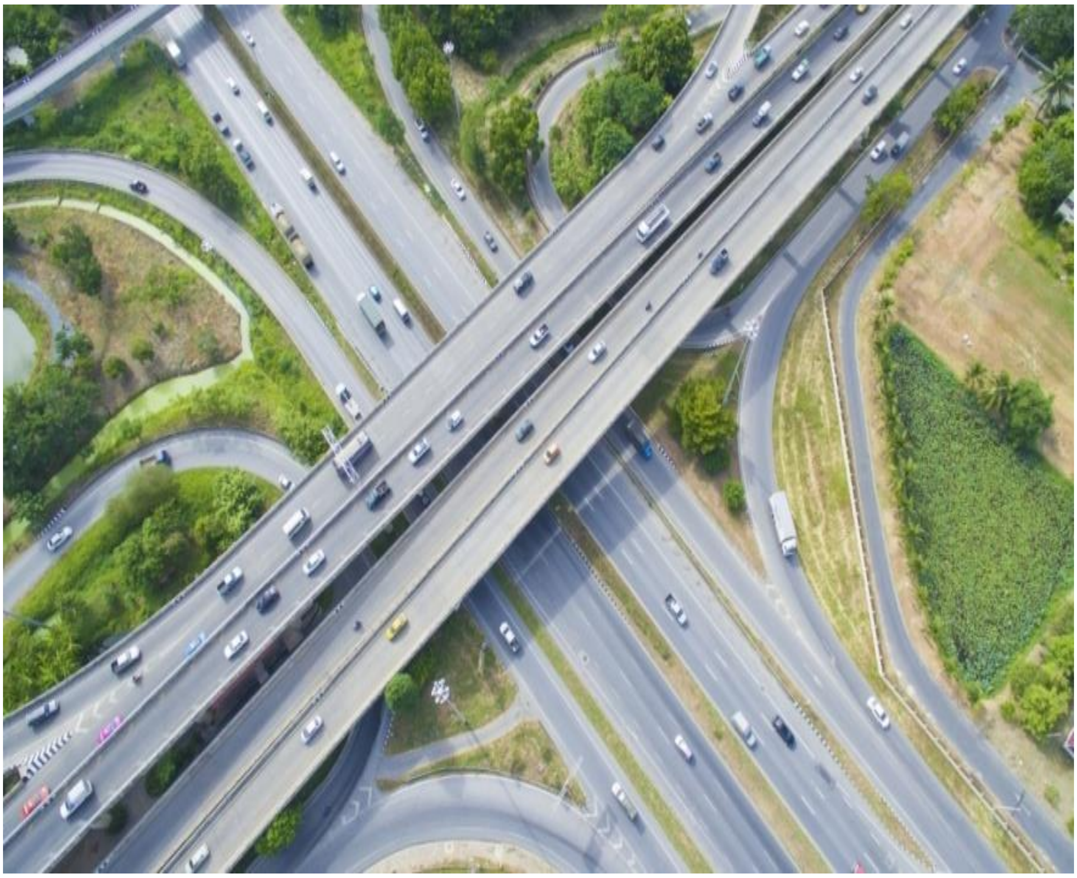


Figure 3Images Showing an Overpass

2.10.3 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 4Image showing a Trumpet Interchange

2.10.4 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.

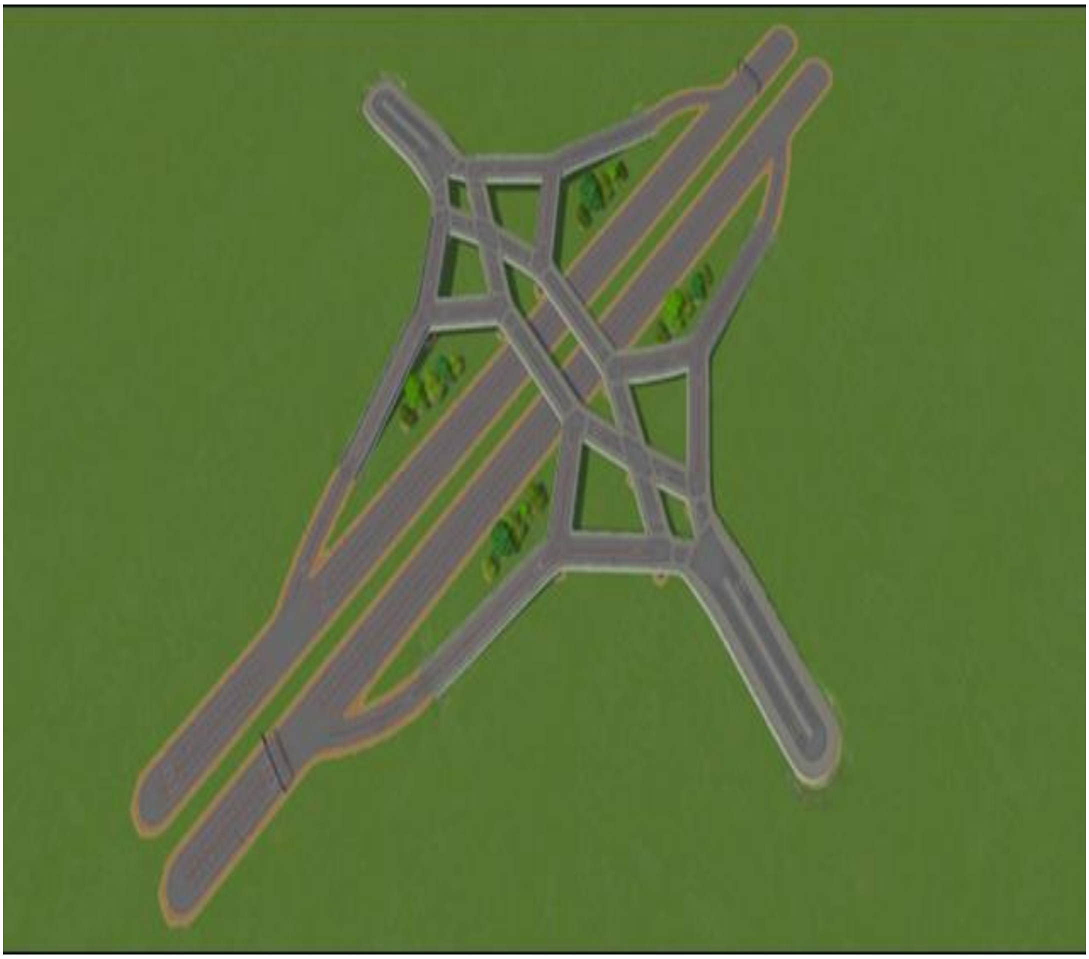


Figure 5 Image showing a Diamond Interchange

2.10.5 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 6 Image Showing a Cloverleaf interchange

2.10.6 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.

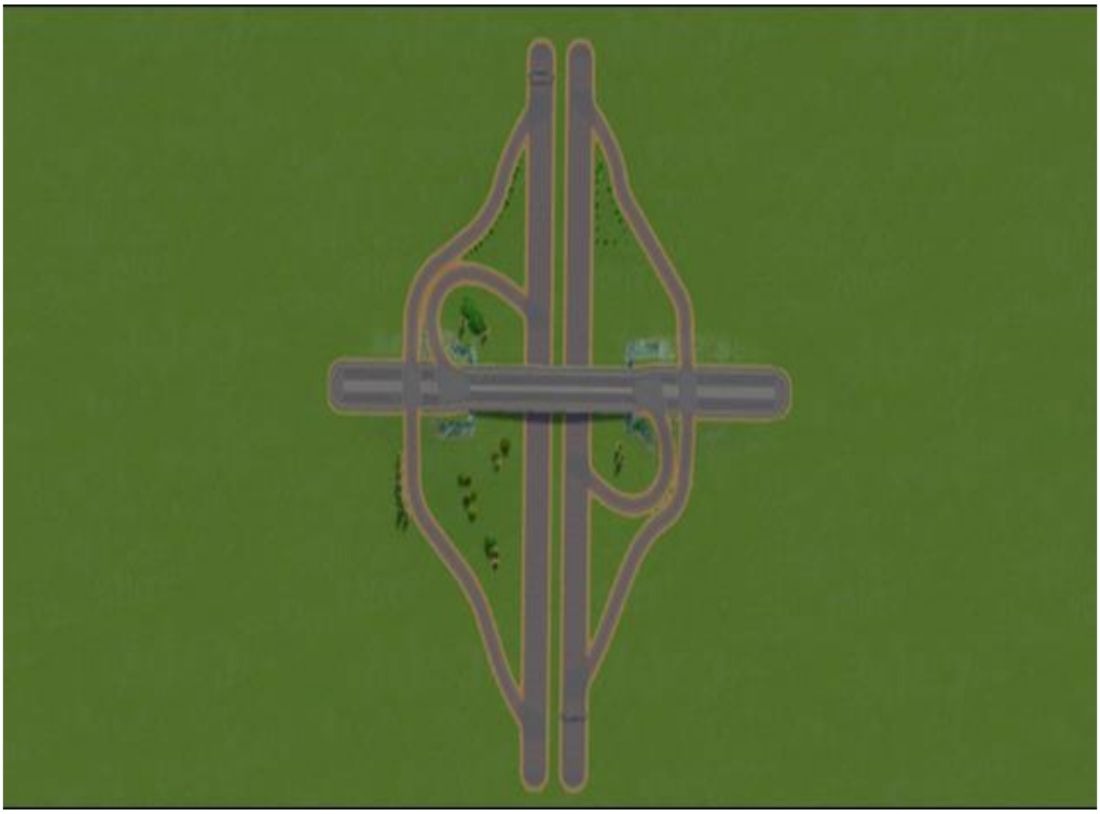


Figure 7 Image showing Partial cloverleaf interchange

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:

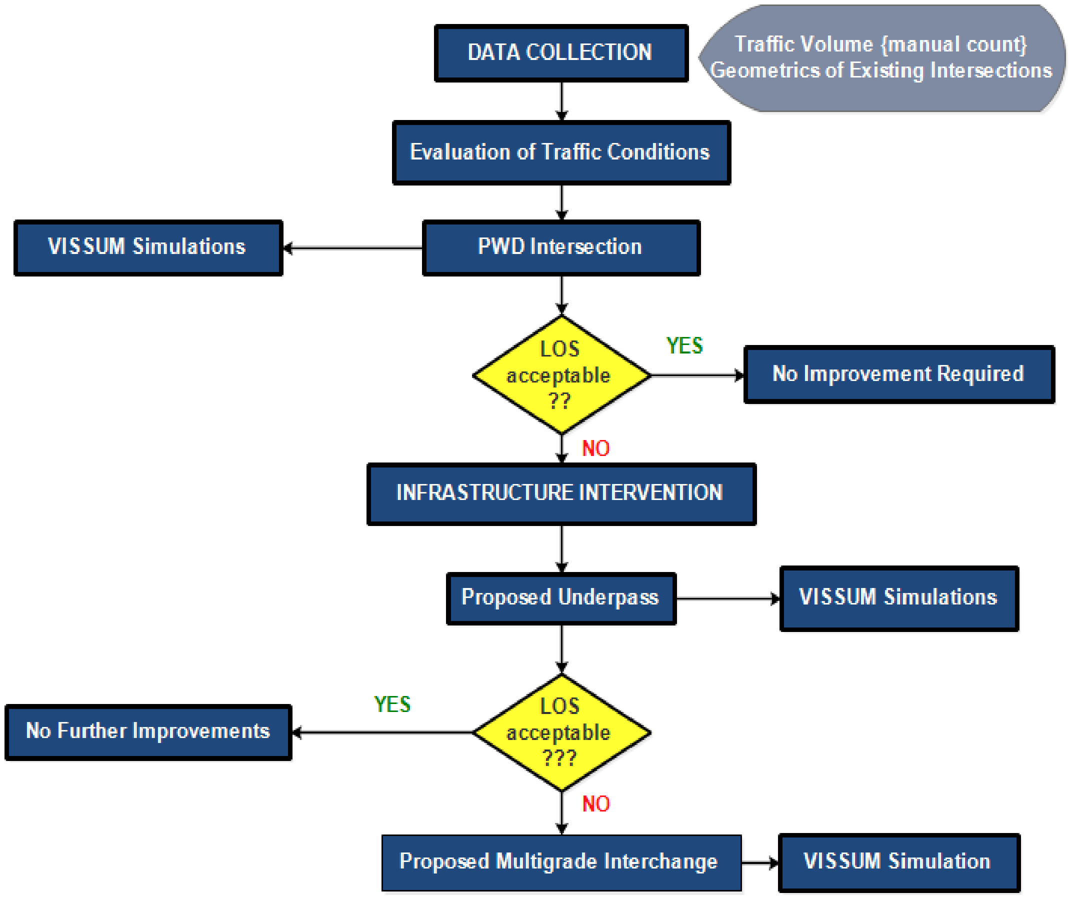


Figure 8 Flowchart showing methodology of the Project

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 PWD Intersection, Rawalpindi were traffic counts, turning volumes and geometric conditions. These were collected at all the 3 legs of the intersection i.e. 2 legs of Islamabad Expressway and PWD Road. The measurements were taken manually from 07:00 am to 9:00 am in mornings and 05:00 to 07:00 pm in the 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 PWD Intersection 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 pre timed operation

3.3 Analysis of existing traffic conditions:

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

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 10 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 10, 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 multi-grade interchange is suggested. It will be a bit 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 VISSIM 10 was 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.

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 solid Thinking Embed as a part of its model 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 solid Thinking 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.

4.2 Getting Started VISSIM:

4.2.1 General Settings:

1. Go to base data then Network settings.

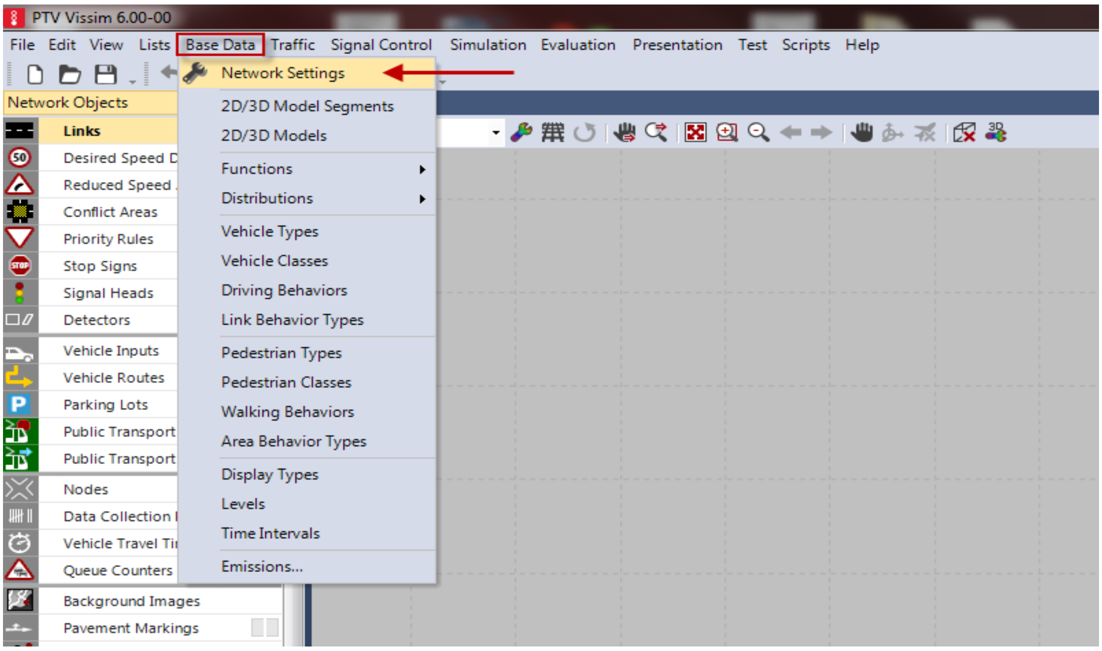


Figure 9 General Settings

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

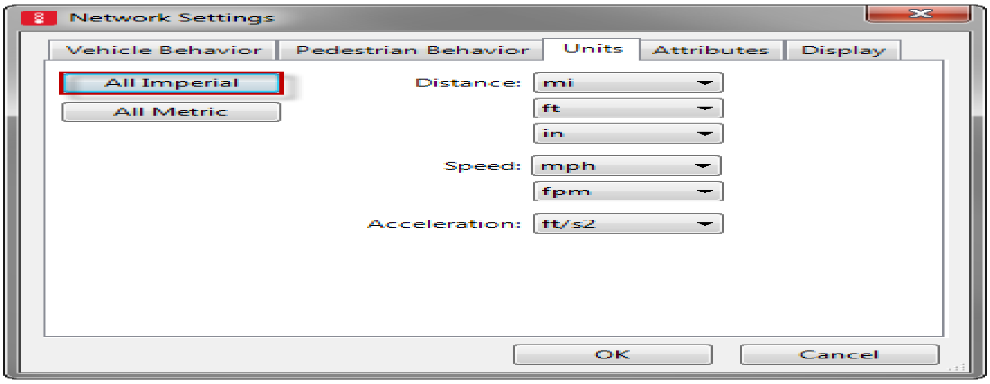


Figure 10 Change units

4.2.2 Build a Network:

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

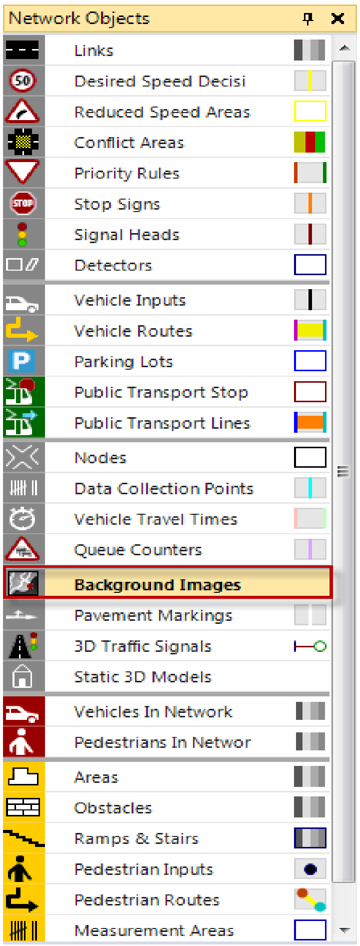


Figure 11 Build Network

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

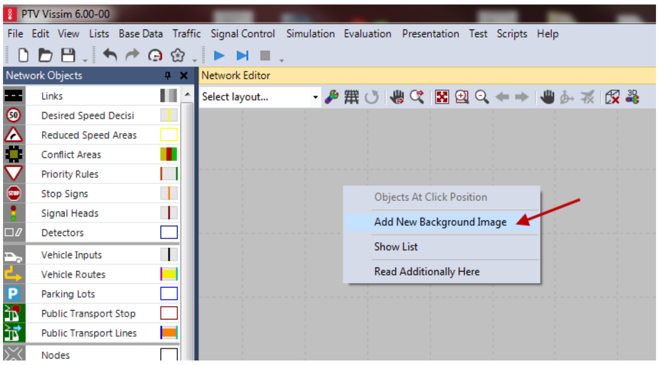


Figure 12 Adding Background Image

3. Enter the data in the following window.

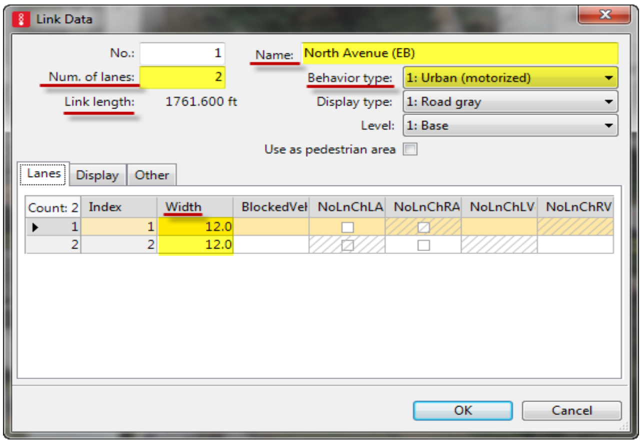


Figure 13 Addition of data for lane

4. Complete connector window.

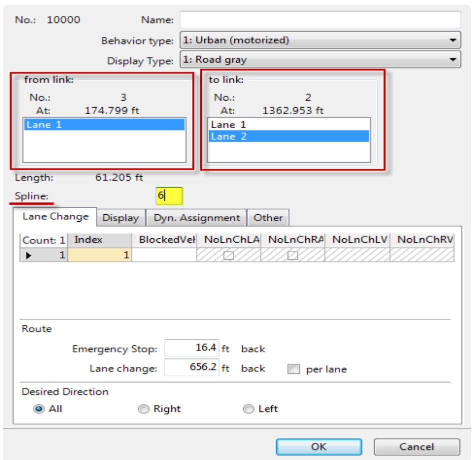


Figure 14 Making Connectors

4.2.3 Add Vehicles:

1. Go to traffic > vehicle composition.

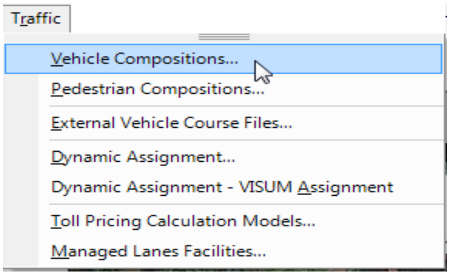
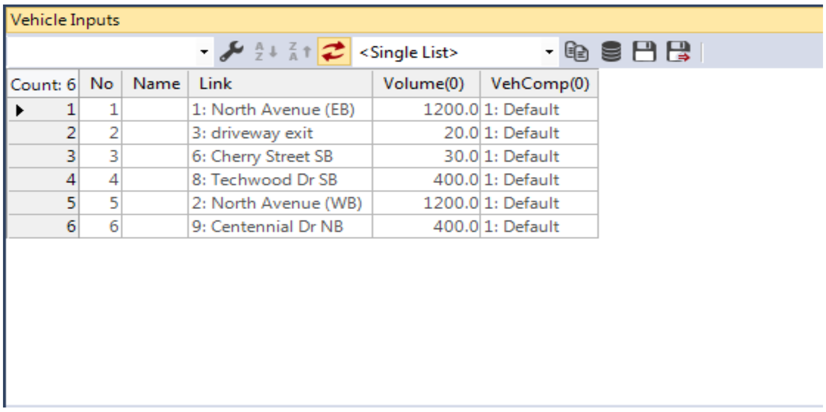


Figure 15 Vehicle composition

2. Enter the volumes in the vehicle inputs.

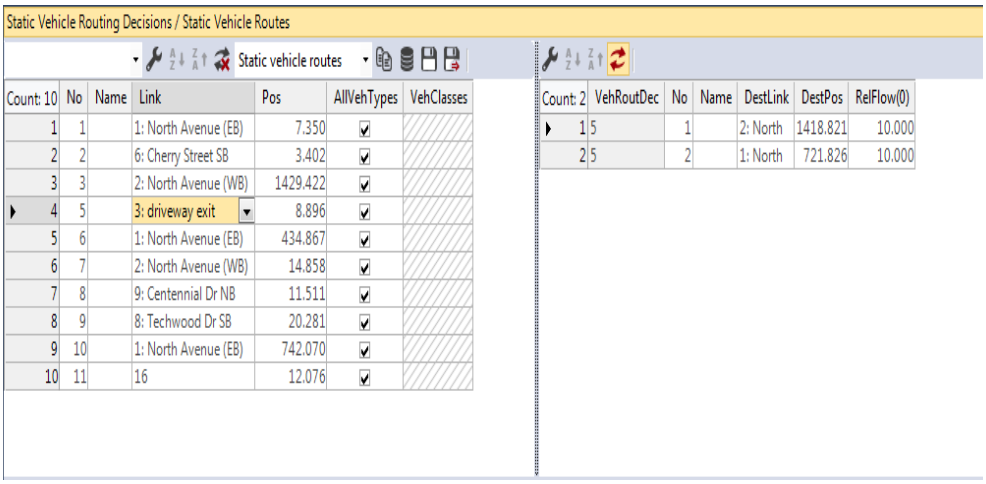

Vehicle Inputs

<Single List>

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 16 Vehicle composition

3. Enter route decisions.


Static Vehicle Routing Decisions / Static Vehicle Routes

Static vehicle routes

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 17 Route Decisions

4.2.4 Add Controls:

1. Add stop control.

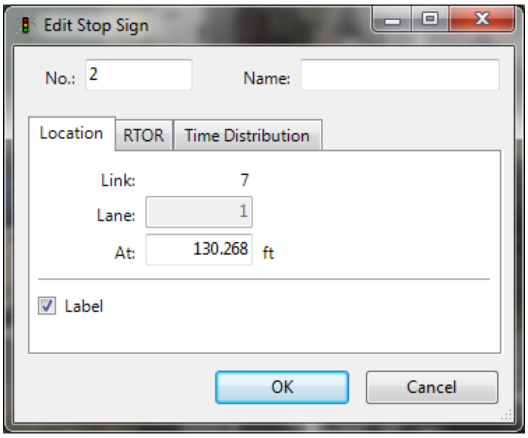


Figure 18 Add Stop Signs

2. Set conflict areas and add signal control.

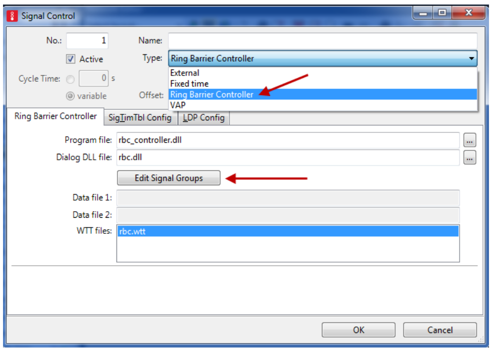


Figure 19 Add signal control

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

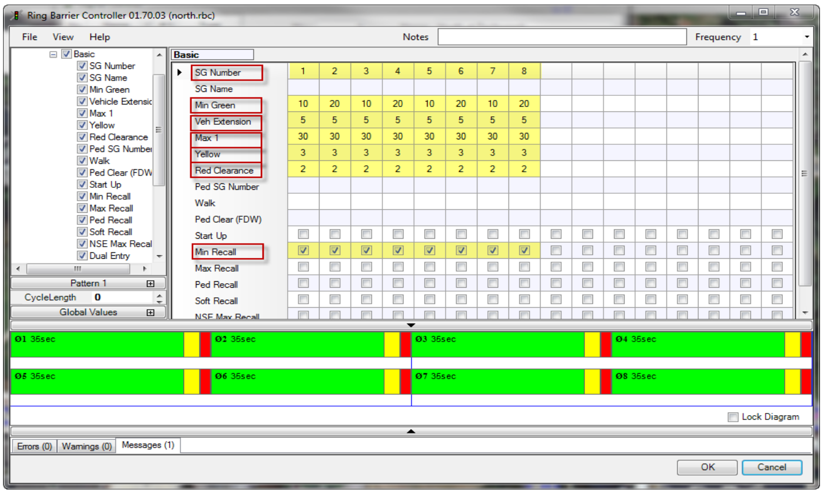


Figure 20 Add timing for signal control

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

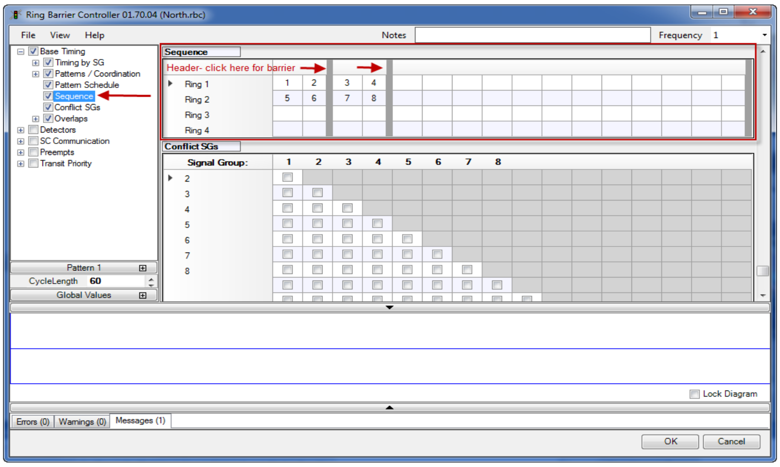


Figure 21 Add sequence for signal control

5. Place signal heads.

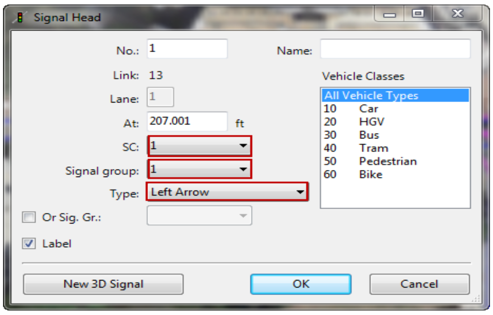


Figure 22 Add signal heads

6. Add detectors to RBC control.

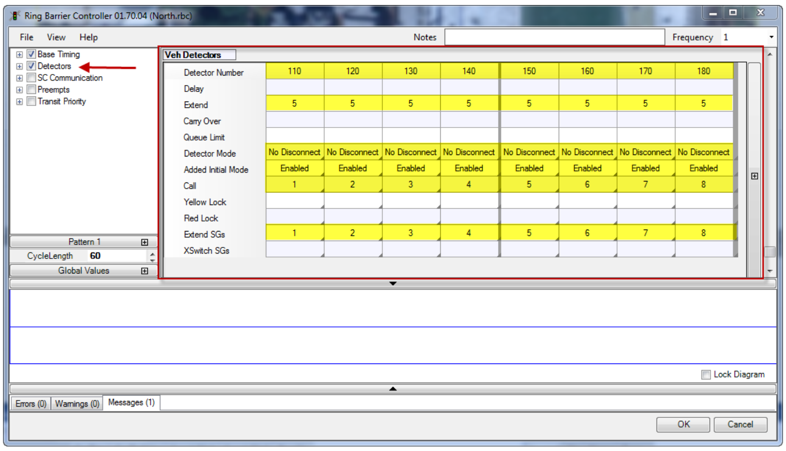


Figure 23 Add detectors

4.2.5 Run Simulation:

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

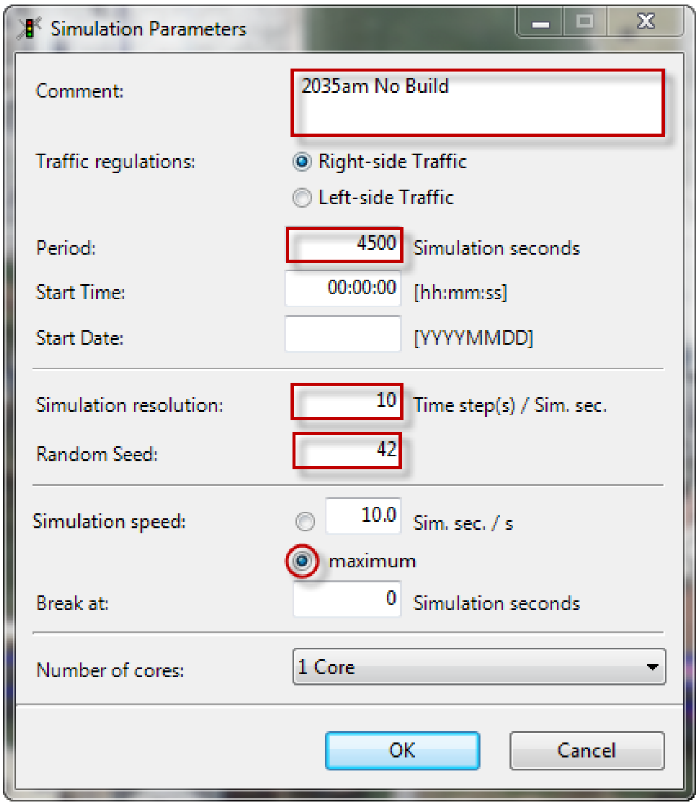


Figure 24 Add Simulations parameters

2. Run the simulation.

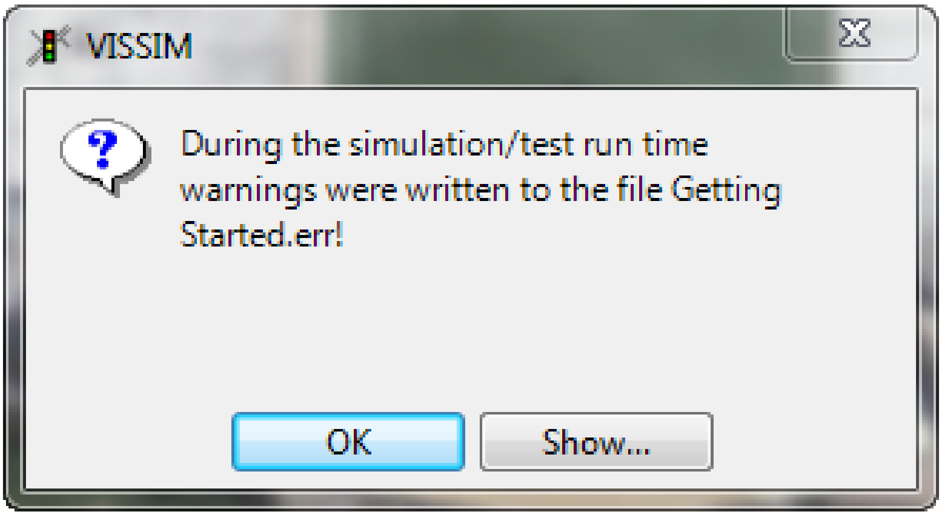


Figure 25 Run Simulations

4.2.6 Output Data:

1. Collect travel time and delay output data.

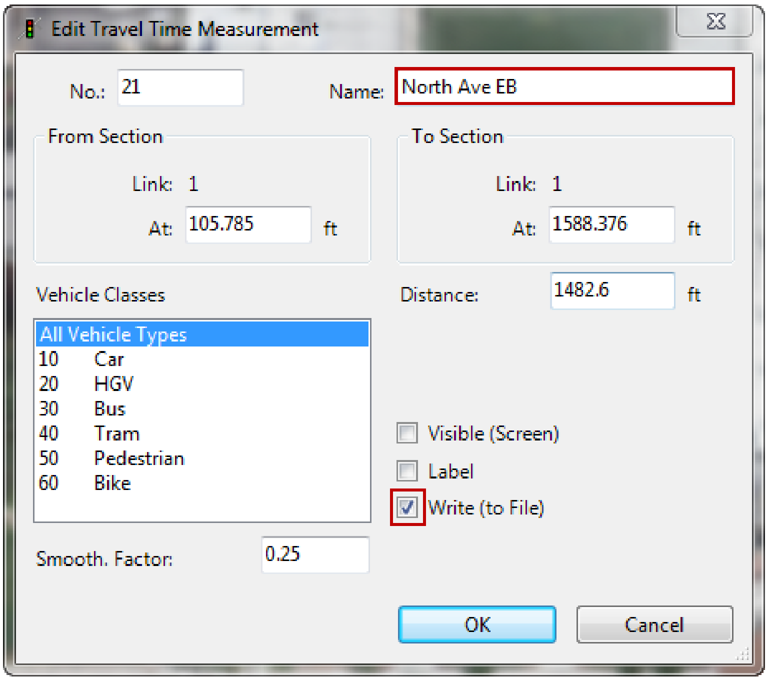


Figure 26 Output data

2. Configure travel time measurement.

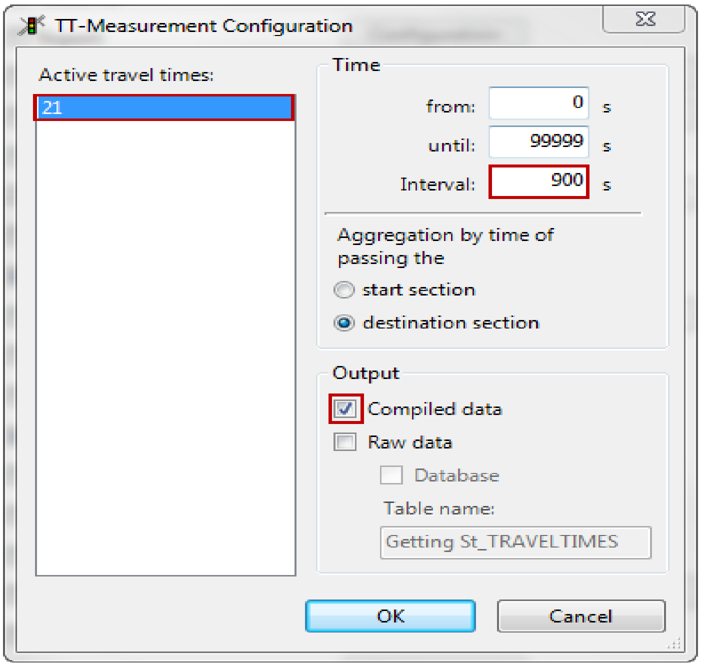


Figure 27 Output data parameters

3. Configure delay measurement.

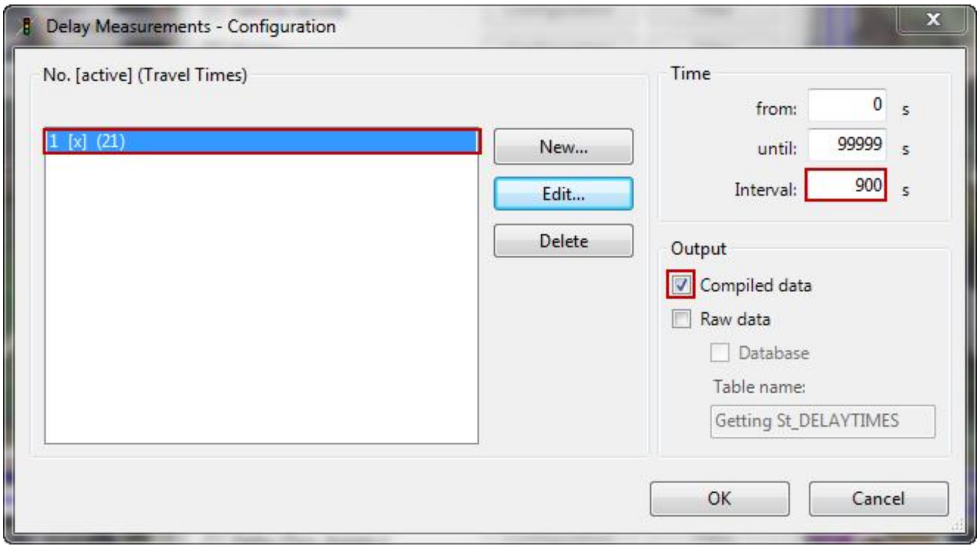
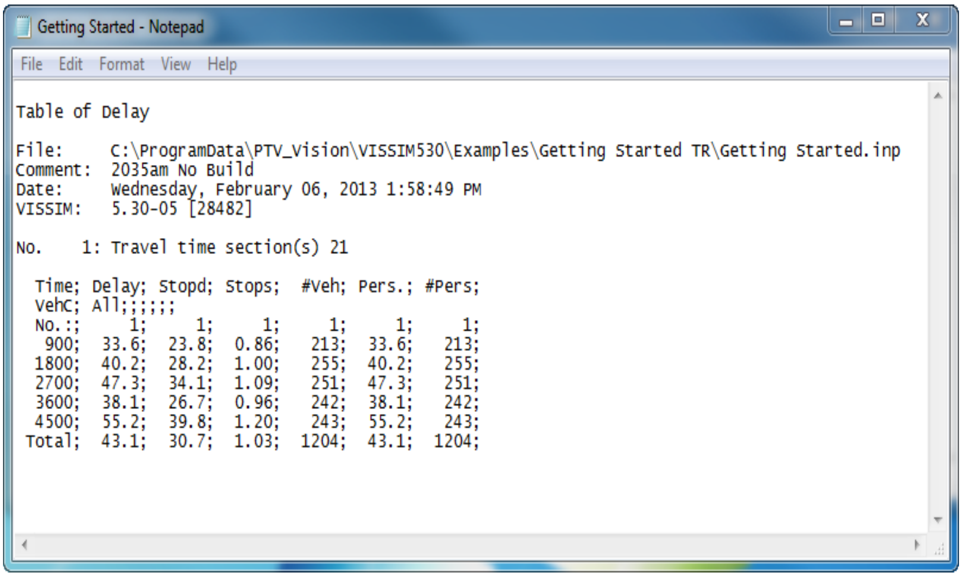


Figure 28 Output data interval setting

4. View travel time and delay output files.



```
Table of Delay

File:     C:\ProgramData\PTV_Vision\VISSIM530\Examples\Getting Started TR\Getting Started.inp
Comment:  2035am No Build
Date:     Wednesday, February 06, 2013 1:58:49 PM
VISSIM:   5.30-05 [28482]

No.    1: Travel time section(s) 21

  Time; Delay; Stopd; Stops;  #Veh; Pers.; #Pers;
  VehC; All;;;;;;
  No.:;     1;     1;     1;     1;     1;     1;
   900;  33.6;  23.8;  0.86;   213;  33.6;   213;
  1800;  40.2;  28.2;  1.00;   255;  40.2;   255;
  2700;  47.3;  34.1;  1.09;   251;  47.3;   251;
  3600;  38.1;  26.7;  0.96;   242;  38.1;   242;
  4500;  55.2;  39.8;  1.20;   243;  55.2;   243;
 Total;  43.1;  30.7;  1.03;  1204;  43.1;  1204;
```

Figure 29 Output Data table

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 PWD intersection in Rawalpindi. In order to ensure, Excel and VISSIM 10 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 PWD intersection were collected manually and through Traffic Police. This data was collected on Thursday and Saturday. 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. PWD intersection’s peak hour of traffic on Thursday Evening was noted between 05:00 pm to 06:00 pm having total traffic volume of 6862 vehicles/hr.

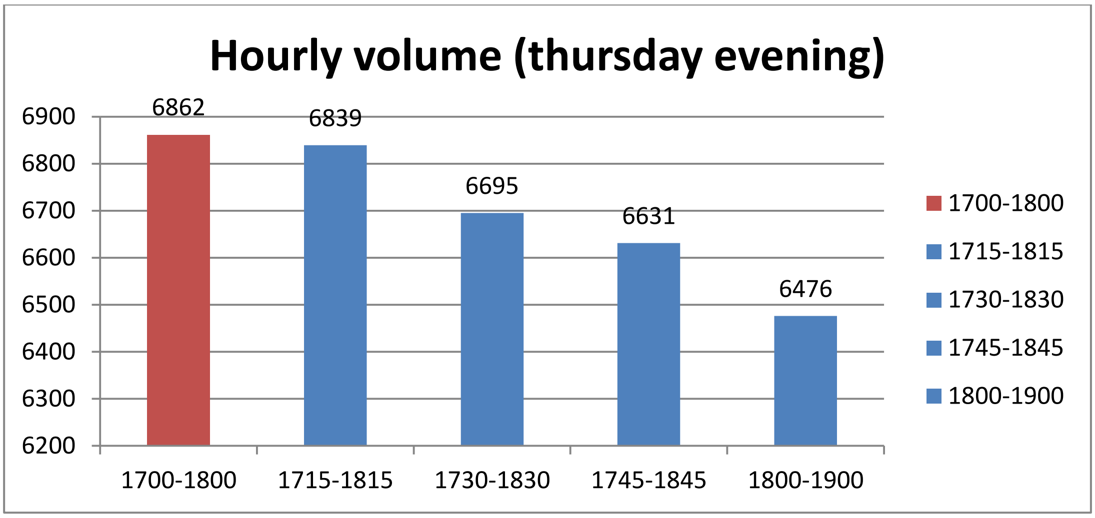


Figure 5.1 Peak Hour Volume at PWD intersection on Thursday Evening

b. PWD intersection's peak hour of traffic on Wednesday Evening was noted between 05:45 pm to 06:45 pm having total traffic volume of 6750 vehs/hr.

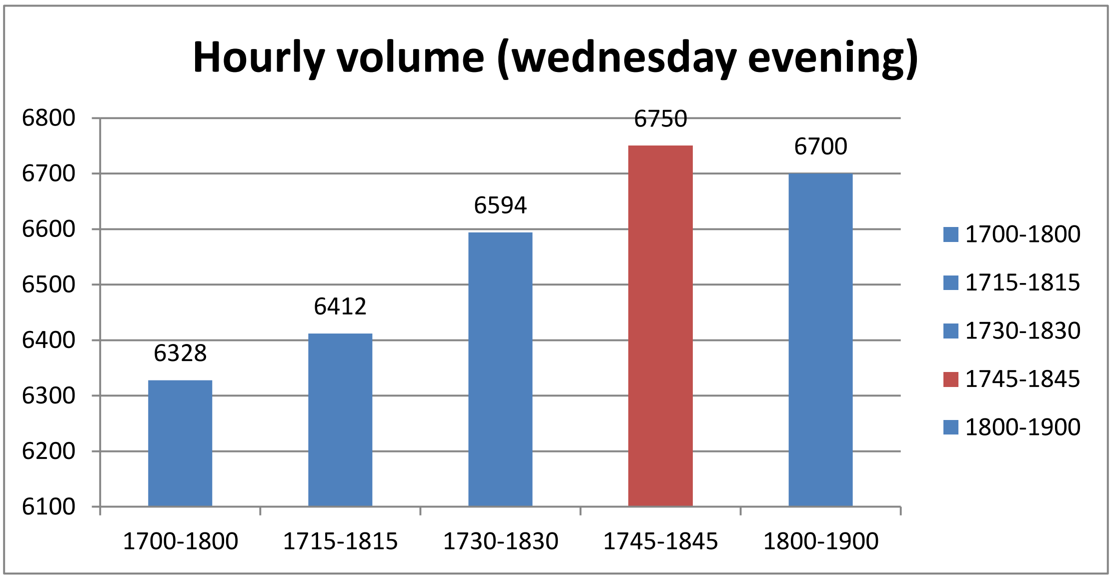


Figure 5.2 Peak hour volume at PWD intersection on Wednesday Evening

c. PWD intersection's peak hour of traffic on Saturday Evening was noted between 05:45 pm to 06:45 pm having total traffic volume of 5536 vehicles/hr.

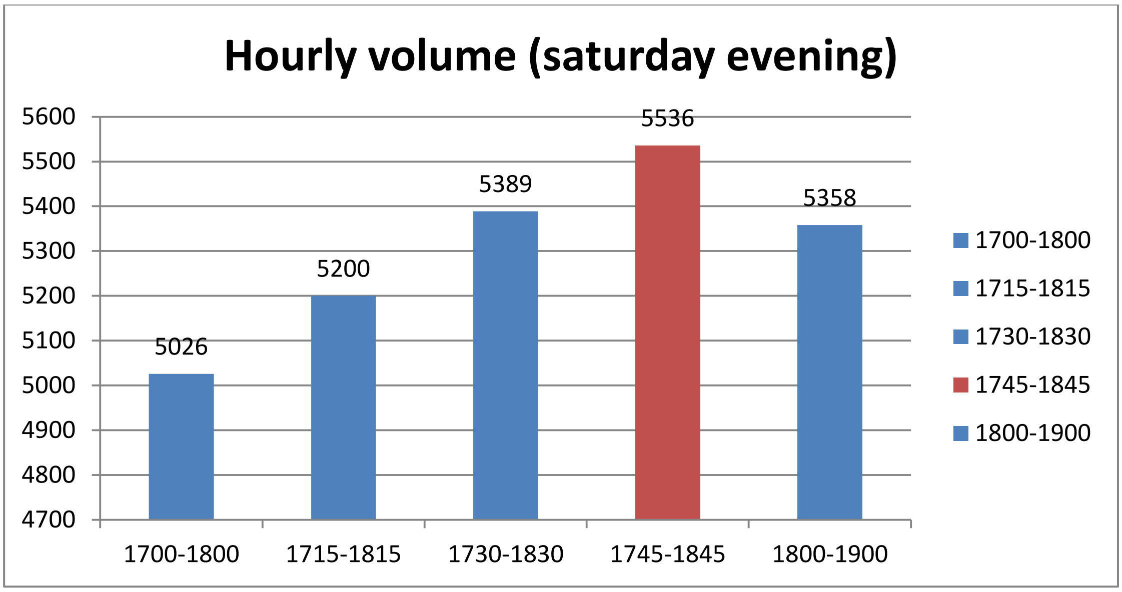


Figure 5.3 Peak hour volume at PWD intersection on Saturday Evening

d. PWD intersection's peak hour of traffic on Saturday Morning was noted between 07:45 am to 08:45 am having total traffic volume of 3976 vehicles/hr.

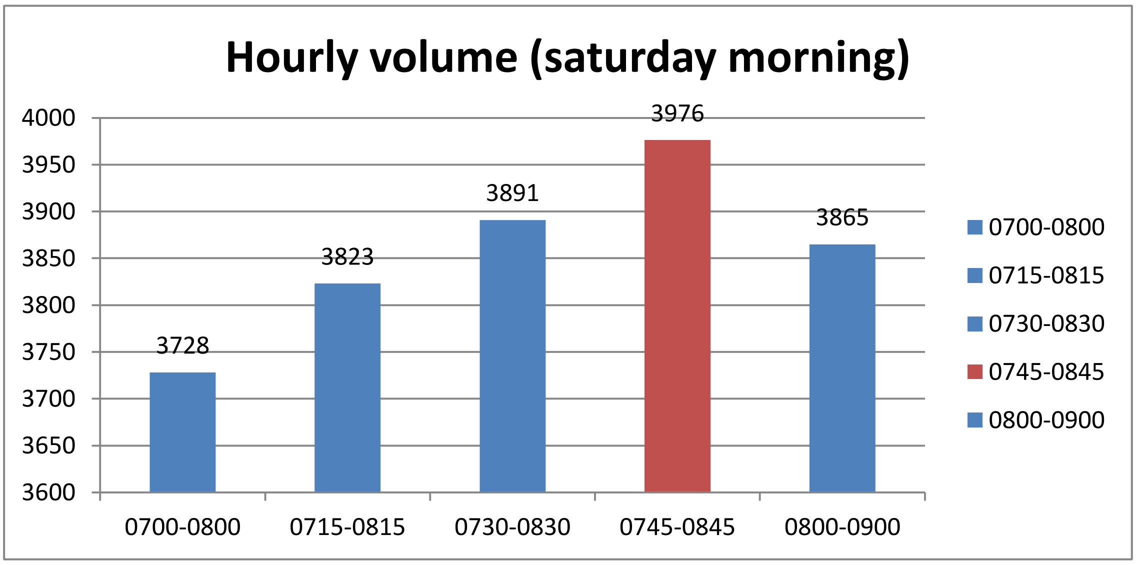


Figure 5.4 Peak hour volume at PWD intersection on Saturday Morning

e. PWD intersection's peak hour of traffic on Wednesday morning was noted between 05:30 am to 06:30 am having total traffic volume of 8035 vehicles/hr.

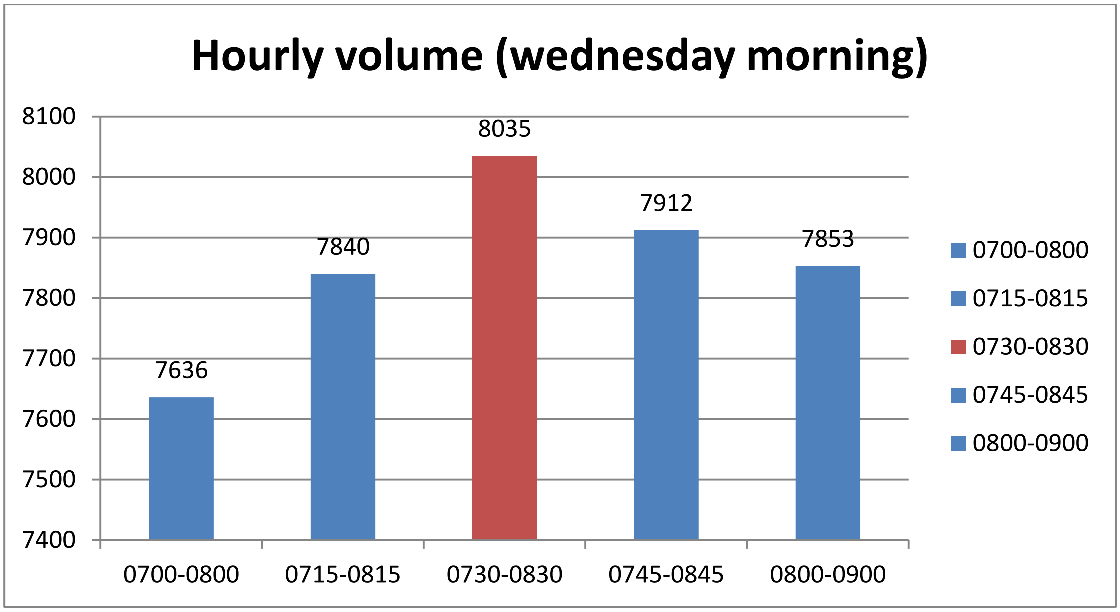


Figure 5.5 Peak hour volume at PWD intersection on Wednesday Morning

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 5.1 below illustrates the PHF for each turning movement for PWD intersection for Wednesday which had the maximum traffic volume.

Approach	Movement	PHF
Islamabad Bound	TH	0.918991
	L	0.965074
Rawat Bound	R	0.838816
	TH	0.919156
PWD Bound	R	0.90295
	L	0.93295

Table 1 showing the PHF values for PWD intersection

5.5 Existing LOS:

PTV VISSIM 10 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 three legged intersection. The LOS at PWD intersection is exhibited in table 5.2.

Table 2 showing the existing LOS at PWD intersection

Approach	Vehicle Delay (seconds)	Existing LOS
Islamabad bound	87.45	F
Rawat bound	141.45	F
PWD bound	134.45	F

5.6 Existing Queue Length:

PTV VISSIM 10 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 three legged intersection. The data is shown below in table 5.3

Approach	Queue Length (ft)
Islamabad bound	216.06
Rawat bound	327.49
PWD bound	281.78

Table 3 showing the Queue length at PWD intersection

5.7 Discussion on Results:

After compiling the results generated by PTV VISSIM 10 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.

CHAPTER – 6

PROPOSED DESIGN ALTERNATIVES

6.1 Introduction:

This chapter includes the proposed design alternatives to overcome the traffic congestion problems of PWD Intersection, 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, trumpet 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 PWD 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 road and ramps.

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%.

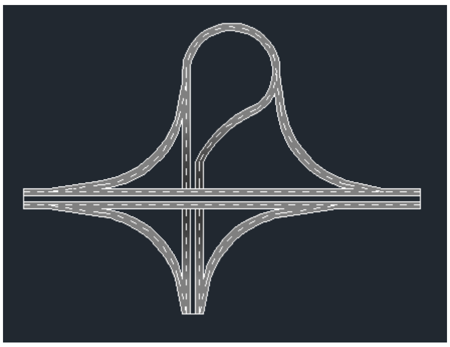


Figure 30 Underpass with Roundabout

6.2.2 Result through Simulations:

The existing traffic data was entered in PTV VISSIM 10 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 PWD intersection for the proposed underpass is shown in table 6.1 below.

Approach	Vehicle Delay (seconds)	Existing LOS
Islamabad bound	3.9	A
Rawat bound	0.9	A
PWD bound	3.35	A

Table 4 showing the existing LOS at PWD intersection

6.2.2.2 Queue Length:

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

Approach	Queue Length (feet)
Islamabad bound	0.00
Rawat bound	0.00
PWD bound	0.00

Table 5 showing the Queue Length at PWD 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 A.

6.3 Proposed New Trumpet Interchange:

6.3.1 Design Parameters:

Following design parameters were set for the proposed options.

a) The overpass should be provided for traffic coming from PWD and going to PWD because of more traffic volume.
b) There should be 2 lanes on each side of overpass which should be 12 feet wide.
c) The remaining traffic should use the at grade road network.
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 31 Trumpet Interchange

6.3.2 Result through Simulations:

The existing traffic data was entered in PTV VISSIM 10 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 PWD intersection for the proposed Trumpet Interchange is shown in table 6.3 below.

Approach	Vehicle Delay (seconds)	Existing LOS
Islamabad bound	1.31	B
Rawat bound	3.91	B
PWD bound	4.73	B

Table 6 showing the existing LOS at PWD intersection

6.3.2.2 Queue Length:

The Queue length at PWD intersection for the proposed Trumpet interchange is shown in table 6.4 below.

Approach	Queue Length (ft)
Islamabad bound	0.00
Rawat bound	0.00
PWD bound	0.00

Table 7 showing the Queue Length at PWD intersection

6.3.3 Advantages:

a) It will be a long term solution and will cater for the future growth.
b) The LOS has been improved from F to B.
c) 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.

CHAPTER–7

Conclusion & Recommendations

This research study was mainly intended 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 10 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 foremost to 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 was PWD Intersection 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 Wednesday, Thursday and Saturday because according to HCM (2000), these days include week days when the traffic is maximum, and a weekend. Here we counted two 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 Thursday, one for Wednesday and one for Saturday). The one which is maximum of these three is the peak hour of that week. Furthermore, the researchers found out the PHF. VISSIM 10 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 were needed 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 trumpet interchange. Few conclusions are drawn:-

a. PWD intersection is causing serious traffic congestion which is revealed by the analysis of VISSIM 10. 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. Trumpet 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.

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Wright, H. P., and Paquette, R. J., *"Highway Engineering"*, 6th Edition, John Wily and Sons, Inc., New York, U.S.A., 1996.

Thursday Evening	Rawat Bound through	PWD Bound right	Rawat Bound right	Isb Bound left	Isb Bound through	PWD Bound left
1700-1715	46	289	19	320	550	46
1715-1730	107	280	20	374	548	107
1730-1745	91	276	22	358	572	91
1745-1800	134	250	19	368	594	134
1800-1815	26	287	21	353	580	26
1815-1830	58	274	20	293	561	58
1830-1845	24	322	20	353	528	24
1845-1900	73	280	18	253	541	73

Wednesday Evening	Rawat Bound through	PWD Bound right	Rawat Bound right	Isb Bound left	Isb Bound through	PWD Bound left
1700-1715	475	280	23	314	400	24
1715-1730	495	294	25	308	405	17
1730-1745	462	306	20	327	420	19
1745-1800	531	310	18	361	490	4
1800-1815	341	198	21	390	564	86
1815-1830	468	326	19	312	575	26
1830-1845	484	322	20	297	574	13
1845-1900	475	309	20	281	551	28

Saturday Evening	Rawat Bound through	PWD Bound right	Rawat Bound right	Isb Bound left	Isb Bound through	PWD Bound left
1700-1715	508	185	23	211	300	10
1715-1730	469	180	25	205	304	5
1730-1745	442	176	20	224	321	4
1745-1800	569	152	18	251	384	40
1800-1815	478	184	21	284	364	80
1815-1830	529	176	19	241	371	41
1830-1845	516	193	20	229	362	14
1845-1900	502	180	20	208	314	12

Saturday Morning	Rawat Bound through	PWD Bound right	Rawat Bound right	Isb Bound left	Isb Bound through	PWD Bound left
0700-0715	283	62	25	164	334	34
0715-0730	303	71	23	156	329	15
0730-0745	305	61	21	162	347	13
0745-0800	369	80	18	214	327	12
0800-0815	331	82	22	205	341	16
0815-0830	308	87	23	189	353	5
0830-0845	326	63	25	170	389	21
0845-0900	327	67	24	162	311	18

Wednesday Morning	Rawat Bound through	PWD Bound right	Rawat Bound right	Isb Bound left	Isb Bound through	PWD Bound left
0700-0715	469	83	45	364	634	261
0715-0730	482	92	51	370	629	244
0730-0745	486	85	60	377	647	261
0745-0800	593	114	54	400	627	208
0800-0815	500	116	76	408	741	219
0815-0830	540	107	65	390	753	208
0830-0845	539	108	47	340	589	170
0845-0900	538	105	48	400	611	235

Thursday Evening

ISB Bound		ISB Bound		PWD Bound		PWD Bound		Rawat Bound		Rawat Bound	
left		through		right		left		through		right	
320		550		289		46		46		19	
374		548		280		107		107		20	
358		572		276		91		91		22	
368	1420	594	2264	250	1095	134	378	134	378	19	80
353	1453	580	2294	287	1093	26	358	26	358	21	82
293	1372	561	2307	274	1087	58	309	58	309	20	82
353	1367	528	2263	322	1133	24	242	24	242	20	80
253	1252	541	2210	280	1163	73	181	73	181	18	79
	1453		2307		1163		378		378		82
	374		594		322		134		134		22
PHF	0.97126		0.97096		0.90295		0.705224		0.70522		0.931818

Saturday Evening

ISB Bound		ISB Bound		PWD Bound		PWD Bound		Rawat Bound		Rawat Bound	
left		through		right		left		through		right	
211		300		185		10		508		23	
205		304		180		5		469		25	
224		321		176		4		442		20	
251	891	384	1309	152	693	40	59	569	1988	18	86
284	964	364	1373	184	692	80	129	478	1958	21	84
241	1000	371	1440	176	688	41	165	529	2018	19	78
229	1005	362	1481	193	705	14	175	516	2092	20	78
208	962	314	1411	180	733	12	147	502	2025	20	80
	1005		1481		733		175		2092		86
	284		384		193		80		569		25
	0.88468		0.964193		0.94948		0.546875		0.91916		0.86

Saturday Morning

ISB Bound		ISB Bound		PWD Bound		PWD Bound		Rawat Bound		Rawat Bound	
left		through		right		left		through		right	
164		334		62		34		283		25	
156		329		71		15		303		23	
162		347		61		13		305		21	
214	696	327	1337	80	274	12	74	369	1260	18	87
205	737	341	1344	82	294	16	56	331	1308	22	84
189	770	353	1368	87	310	5	46	308	1313	23	84
170	778	389	1410	63	312	21	54	326	1334	25	88
162	726	311	1394	67	299	18	60	327	1292	24	94
	778		1410		312		74		1334		94
	214		389		87		34		369		25
	0.90888		0.90617		0.89655		0.544118		0.90379		0.94

Wednesday Morning

ISB Bound		ISB Bound		PWD Bound		PWD Bound		Rawat Bound		Rawat Bound	
left		through		right		left		through		right	
364		634		83		261		469		45	
370		629		92		244		482		51	
377		647		85		261		486		60	
400	1511	627	2537	114	374	208	974	593	2030	54	210
408	1555	741	2644	116	407	219	932	500	2061	76	241
390	1575	753	2768	107	422	208	896	540	2119	65	255
340	1538	589	2710	108	445	170	805	539	2172	47	242
400	1538	611	2694	105	436	235	832	538	2117	48	236
	1575		2768		445		974		2172		255
	408		753		116		261		593		76
	0.96507		0.918991		0.95905		0.93295		0.91568		0.838816

Wednesday Evening

ISB Bound		ISB Bound		PWD Bound		PWD Bound		Rawat Bound		Rawat Bound	
left		through		right		left		through		right	
314		400		280		24		475		23	
308		405		294		17		495		25	
327		420		306		19		462		20	
361	1310	490	1715	310	1190	4	64	531	1963	18	86
390	1386	564	1879	198	1108	86	126	341	1829	21	84
312	1390	575	2049	326	1140	26	135	468	1802	19	78
297	1360	574	2203	322	1156	13	129	484	1824	20	78
281	1280	551	2264	309	1155	28	153	475	1768	20	80
	1390		2264		1190		153		1963		86
	390		575		326		86		531		25
	0.89103		0.984348		0.91258		0.444767		0.9242		0.86