SIMULATION OF AN INTERSECTION USING PTV VISSIM

A THESIS REPORT

Submitted in partial fulfillment of the requirements for the award of the degree

of

MASTER OF TECHNOLOGY

IN

CIVIL ENGINEERING

With specialization in

CONSTRUCTION MANAGEMENT

Under the supervision of

Dr. Ashok Kumar Gupta (Professor and Head of Department)

and

Mr. Akash Bhardwaj (Assistant Professor)

by

Pranjal Sharma (192601)

to

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

विद्या तत्व ज्योतिसमः

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT, SOLAN – 173234

HIMACHAL PRADESH, INDIA

May - 2021

STUDENT'S DECLARATION

I hereby declare that the work presented in the Project report entitled **Simulation of an Intersection using PTV vissim** submitted for partial fulfillment of the requirements for the degree of Master of Technology in Civil Engineering at **Jaypee University of Information Technology, Waknaghat** is an authentic record of my work carried out under the supervision of **Dr. Ashok Kumar Gupta** and **Mr. Akash Bhardwaj.** This work has not been submitted elsewhere for the reward of any other degree/diploma. I am fully responsible for the contents of my project report.

Signature of student

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Date: 18-05-2021

CERTIFICATE

This is to certify that the work which is being presented in the project title **Simulation of an Intersection using PTV vissim** in partial fulfillment of the requirements for the award of the degree of Master of Technology submitted in Civil Engineering Department, **Jaypee University of Information Technology, Waknaghat** is an authentic record of work carried out by **Pranjal Sharma (192601)** during a period from June 2020 to May 2021 under the supervision of **Dr. Ashok Kumar Gupta** and **Mr. Akash Bhardwaj** Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of my knowledge.

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ABSTRACT

India is still in its early stages of development. On the other hand, traffic in India is relatively heterogeneous or mixed in character, and the average vehicle growth rate in India is around 8%. With India's increasing urbanisation, there would be a significant rise in traffic and travel on the roadways, resulting in vehicle delays, long lines, and traffic congestion.

So, in this research with the help of traffic simulation software i.e. VISSIM, Three simulation of an unsignalised intersection {Dadour and Una-Jahu, Nerchowk Rd. (NH-21),H.P} will be analyzed and will compare them on the basis of vehicular delays and long queues . These three simulations will be analyzed on the basis of:

- Real world traffic data which is less from the expectations due to the pandemic covid-19
- Theoretical traffic data (increase in real data by 30%)
- Theoretical traffic data {with traffic signals as theoretical data follows warrant 1 (Min. Vehicular Volume) shown in IRC:93:1985}

Result showed that with the increase in vehicular data there was not so much variation in vehicular delays whereas there was an increase in long queues or queue stops and while third simulation (with traffic lights) is done it shows that it overcome the queue stops and also decreases conflict points of the intersection.

Keywords: Vissim, Intersection, Building Components, Simulation

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LIST OF ACRONYMS

ACUTA	Autonomous Control of Urban Traffic
CORSIM	Corridor Simulation
PTV	Planung Transport Verkehr AG
SIDRA	Signalized and Unsignalized Intersection Design and Research Aid
SSAM	Surrogate Safety Assessment Model

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CHAPTER-1

INTRODUCTION

1.1 General

Due to the increase in traffic and increasing technology traffic engineers are mostly using microscopic simulation models in recent years. These simulation purposes are to analyse and optimize traffic flows without disturbing the existing traffic, or put people at the level of risk.

1.2 Intersection

Road Intersections are perilous component of a road section. They are normally the most important bottleneck to smooth flow of traffic and a major crash (accident) point. In both urban and rural areas the general principles of design are same. The difference lies only in the sight distance available, design speed, restriction on available land and the availability of pedestrians and cyclists in large volume in urban areas.

Basically intersections are of three types depending on the traffic conditions, these are:

- Uncontrolled Intersections at-grade: In these intersections volume of traffic is low on both roads and traffic of neither road has priority over the other.
- Intersection with priority control: Cars on the major road are not delayed at these intersections, however vehicles on local roads are regulated by a Give-way or Stop sign.
- Signalised Intersection/Time separated Intersections at grade: For signalised intersection detailed warrants are laid down in IRC: 93:1985. A signalised junction is appropriate, among other things, if the major road has a traffic volume of 650 to 800 vehicles per hour (both directions) and Minor Street has 200 to 250 vehicles per hour in one direction alone.

Road intersections occur in variety of shapes. They are divided into seven basic forms i.e. Y, T, Cross, Staggered, Skewed and Staggered and multiway. In this research unsignalised Intersection {Dadour and Una-Jahu, Nerchowk Rd. (NH-21)} is adopted because of the following problems:

- Misjudgment of gaps in traffic
- Insufficient traffic management system
- Poor road maintenance
- Accident prone area
- No proper channelized intersection
- Absence of footpath, pedestrian crossing
- No U turn allowed

The intersection is in T shape which is shown in Fig.1.1

Fig.1.1 Dadour and Una-Jahu, Nerchowk Rd. (NH-21), H.P

1.2.1 Conflict Points

Wherever there is an intersection which is the area where two or more roads joins or crosses and change in direction of movement occurs there will be always some conflict points which are classified as Crossing conflicts (Major Conflicts), Merging and Diverging conflicts (Minor Conflicts). The main purpose of the intersection design is to minimise the severity and number of potential conflicts between buses, trucks, cars, bicycles and pedestrian and this can be done by: Traffic signals and by access control islands through channelizing.

In this intersection there are 9 Conflict points as shown in fig.1.2. So, to overcome these conflict points traffic signal method is used whereas island channelizing method can't be used here because it requires more area which is not possible in this case as the area is not that much large.

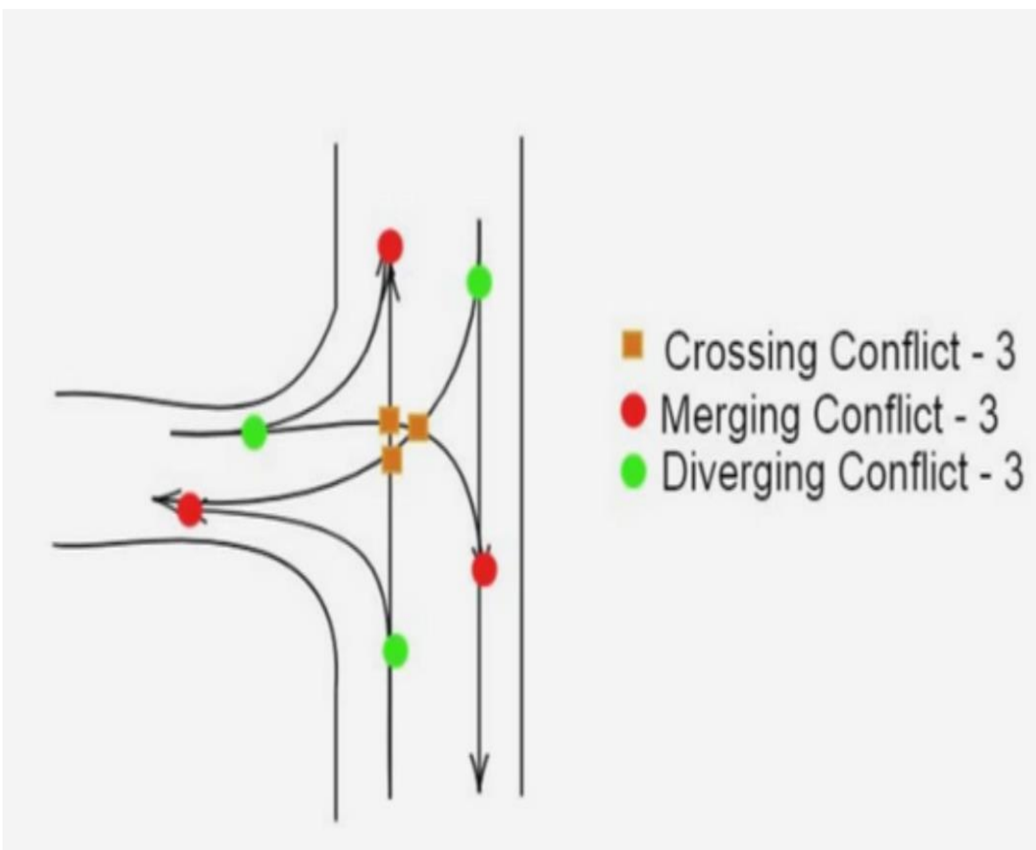


Fig.1.2 T-Intersection Conflict points

1.3 Traffic Signals

Traffic signals are one of the most efficient and versatile active traffic management systems available, and they are extensively utilised in many cities across the world.

1.3.1 Cycle: A signal cycle is one full rotation of all of the available indicators.

1.3.2 Cycle length (C): The time it takes for a signal to complete one full cycle of indications is measured in seconds. It represents the time gap between the start of a green for one approach and the start of the green for the following approach.

1.3.3 Intervals: It signifies the transition from one stage to the next. There are two different sorts of waits:

- **Change Interval:** It is also known as yellow time / clearance amber / amber. It is the time interval between green time and red time. Its purpose is to warn traffic about upcoming red signal and gives time for traffic which has entered the intersection to clear it before the green time for next phase starts.
- **Clearance Interval:** Also known by the name all red interval. It is added after each yellow interval and it indicates a period during all phases shown red signs. It is used for clearing vehicle from intersection. All red interval is optional and generally not provided for small intersections. For calculations, all red interval is taken as part of amber.

1.4 Traffic Signal Design

There are six key phases in the signal design process:

- Phase design
- Amber time determination
- Cycle length determination
- Green time apportionment
- Pedestrian crossing
- Design performance evaluation

Methods to design traffic signal are:

- Trial Method
- Approximate Method
- Webster Method
- IRC Method

The Webster approach is commonly used since the design is straightforward and is based on formulas directly provided by Webster. The whole cycle of the signal is resolved in this manner, resulting in a total least delay happening at signal.

1.5 PTV Vissim

PTV Vissim is a multifunction microscopic traffic simulation that is based on traffic behaviour. It was created by the Karlsruhe-based PTV Planung Transport Verkehr AG. There are many more simulation software's but vissim gives more accurate result as compared to other software's. Mostly the software is adapted for traffic engineers.

Any traffic simulator that represents the carriage hoard framework by modelling the organisational and technological perspectives of the corporal carriage hoard must use a scientific or mathematical model. Following that, a mandate model is built to fulfil the public's and vehicles' requests. Traveling on the hoard structure necessitates a very detailed model of the transportation regulator based on the hoard and plea.

Hence the three foremost components of structure adding one more component which generates the result of each simulation exercise in simulator are listed below:

- Infrastructure
- Traffic
- Control
- Output

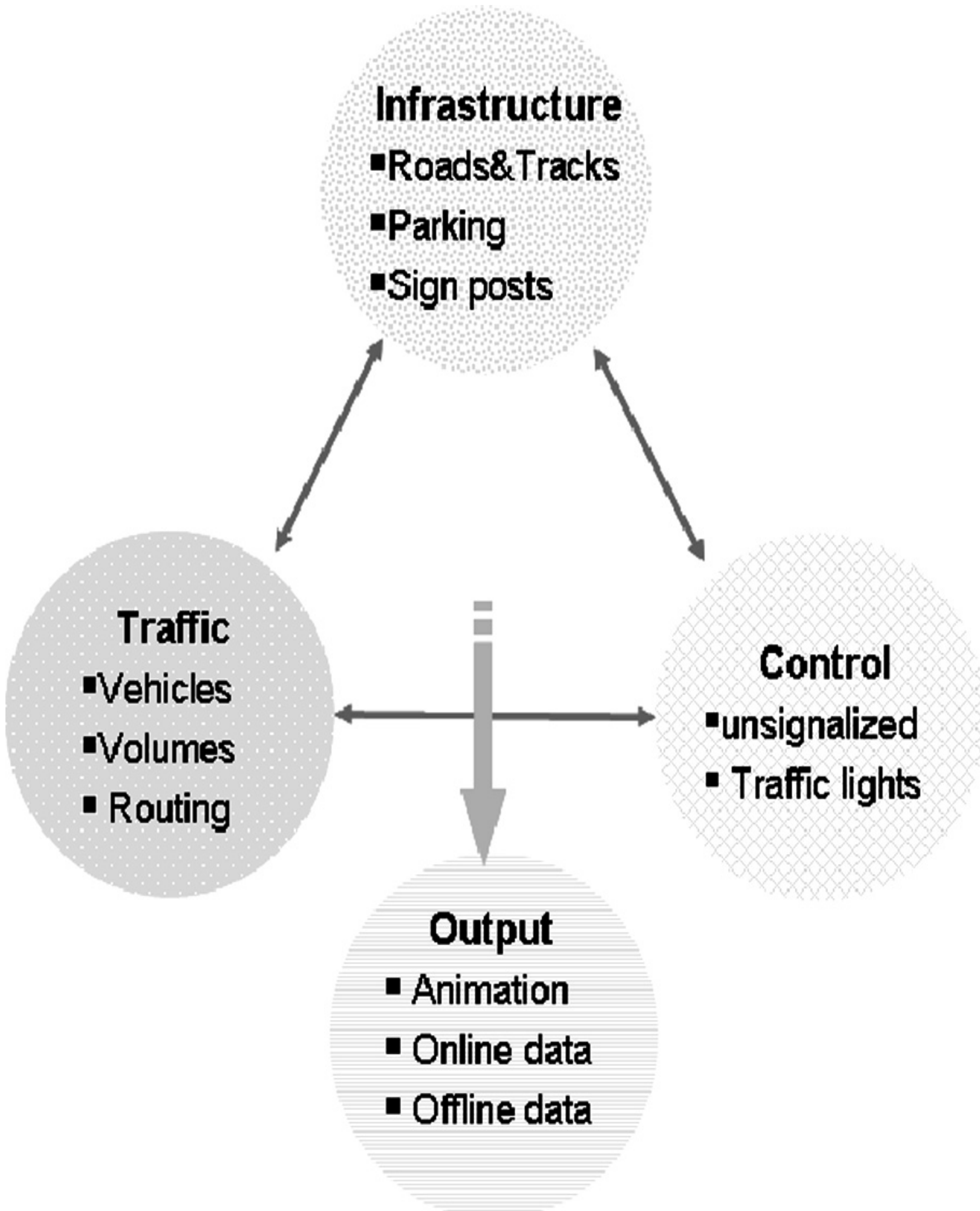


Fig.1.3 Building Components of Vissim

1.6 Building Components

1.6.1 1st Building component (Infrastructure)

The 1st building component is compose of the sign posts, parking facilities, road and railway infrastructure. To mimic the railways and real roadways, this component is necessary. As the starting and ending places of travels, public transportation stops and parking lots are necessary. These are also the part of the 1st component as these are some elements of physical and stationary network and at last immobile rudiments are detectors and symbol markers positioned on the railway and road substructure reflected to be the share of the substructure component.

1.6.2 2nd Building component (Traffic)

In the 2nd component vehicle technical features and traffic flow specifications are involved. Traffic is defined by generating traffic at link entries or by origin destination matrices. The path flow description is the part of this component. As a sequence of links and stops public transport are defined within this component.

1.6.3 3rd Building component (Control)

It contains all of the components required to regulate or control traffic. In this component, non-grade separated junctions are grouped by regulations in order to be clear. Four-way stop characterization, major/minor priority rules with gap reception, and traffic signal management options are all included in this component. Signalization, which comprises specifications for signal setup and triggered control, is part of the traffic control component, despite the fact that a signal post with signal heads is part of the infrastructure component.

As demonstrated in fig.1.3, all three components are interdependent. Cars (component 2) may activate detectors (component 1), impacting vehicle-actuated signal control during a traffic flow simulation (component 3). As a result, all three components are continually active during the simulation, with interconnections between them.

1.6.4 4th Building component (Output)

This component provides the output of all simulations. The data collected by the first three components is processed by the evaluation component. Output generated can either as animated vehicles, pie chart, statistical data and vehicles states.

1.7 Infrastructure Modelling

The level of detail necessary to replicate the roadway infrastructure is determined by the VISSIM software's persistence. A basic sketch is adequate for analyzing the junction for traffic-actuated signal logic analysis, but a detailed model is required for thorough simulation assessments, and the model must always be replicated to scale. Scaled network can be manually traced or can imported from CAD drawings, aerial photographs etc.

The infrastructure of road is modelled by some network objects (elements) which are shown in Figure 1.4

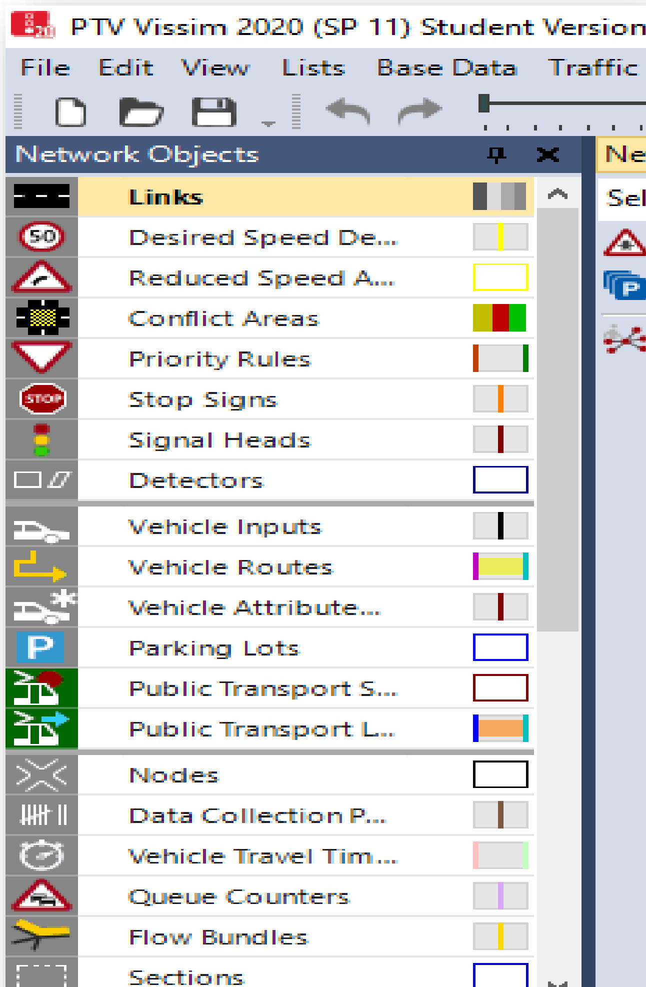


Fig.1.4 Network Objects in Vissim

1.7.1 Links and connectors

The essential component of the VISSIM network is the link. It signifies single or multiple-lane roadway section that has one definite direction of flow. Therefore, a two-way roadway is made of two links with opposite direction of flow. A network can be assembled by connecting these links with connectors. Only connected links permit for continuing traffic. Links that basically overlap or cross one another (without connectors) have no contact with each other.

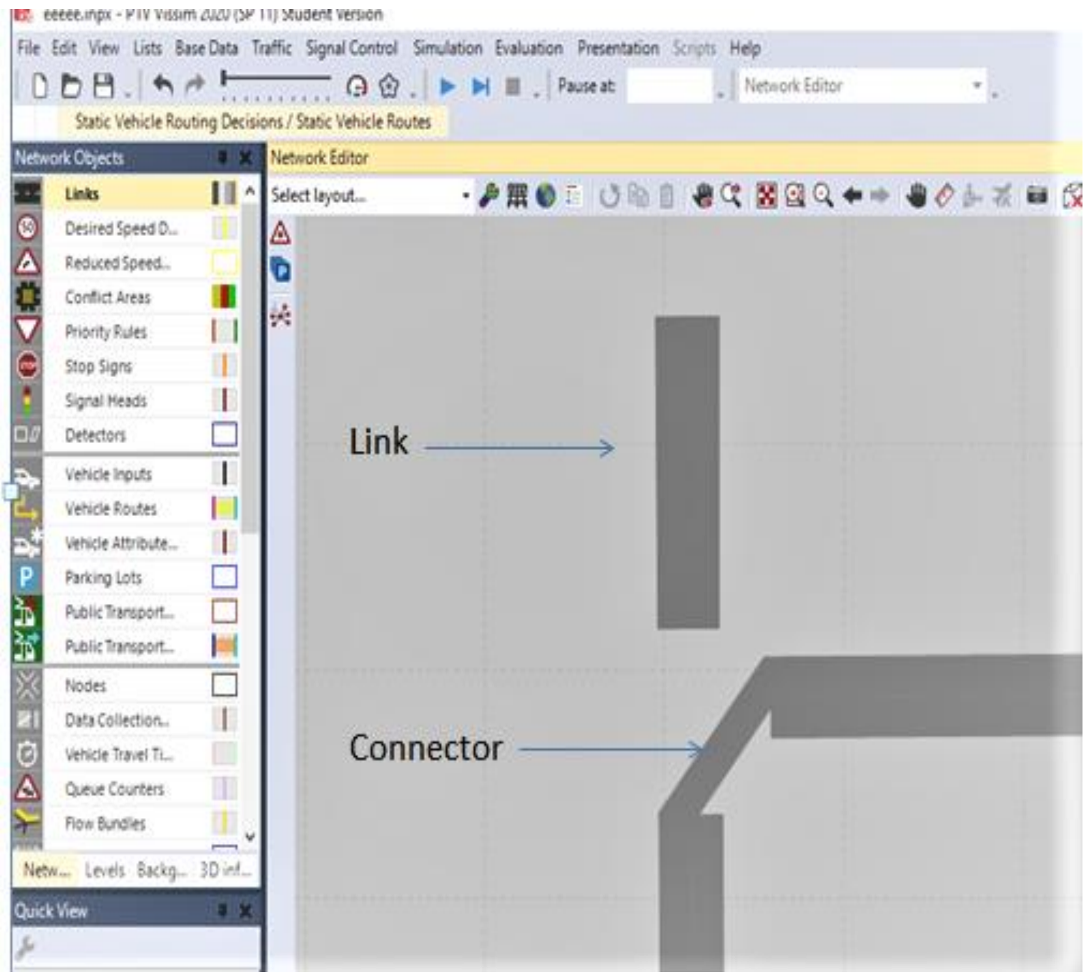


Fig.1.5 Link and Connector in Vissim

1.7.2 Other Network objects (elements)

The essential construction components are links and connections and rest all other elements are as follows:

- Desired speed decisions: The intended speed of vehicle will be changed to match the displayed speed when vehicle will pass this sign.

- Yield and stop signs: These signs represents that minor vehicle will wait until major vehicle passes.

Fig.1.6 Yield and stop sign

- Signal Head: It shows red and green period. It is positioned at the stop bar on the road in simulation. Majorly provided at intersection where volume of traffic is very high.

Fig.1.7 Signal Head

- Reduce speed areas: It is that portion of a link or connector where altered anticipated speed of vehicle act. Basically vehicle will turn with low speed while turning and then come back to its normal haste.

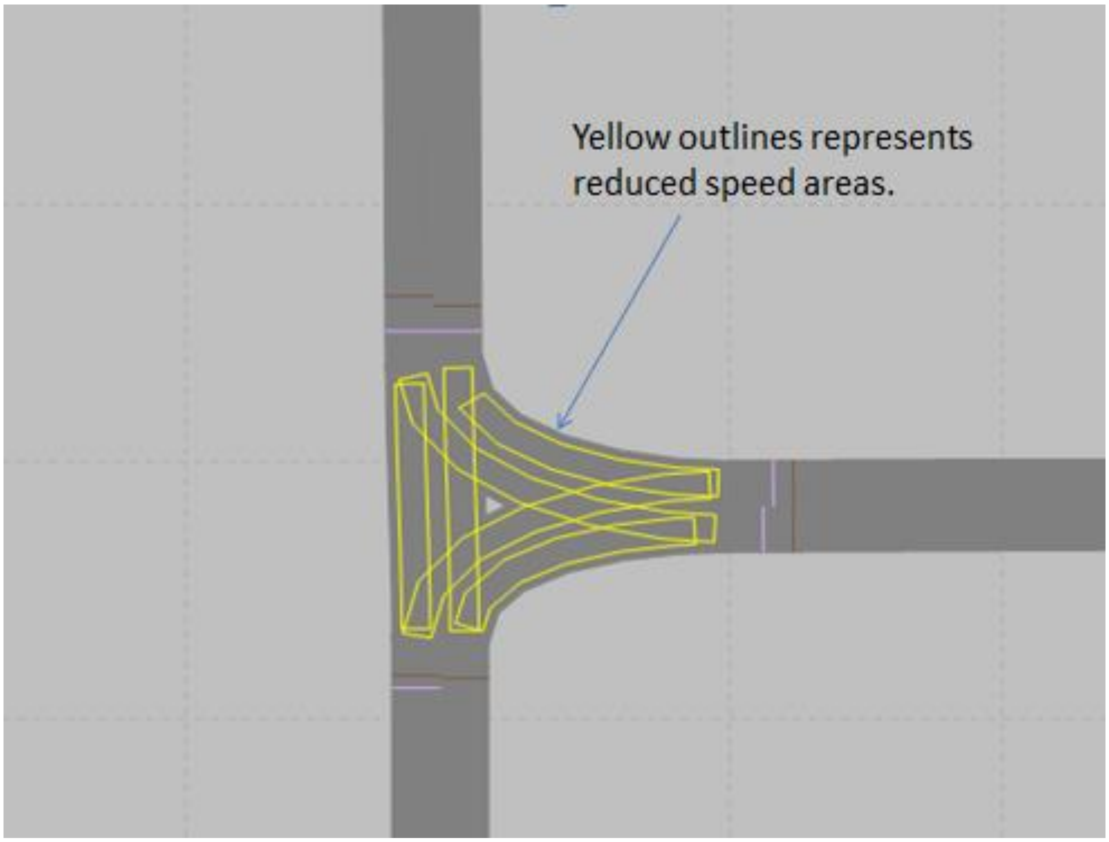


Fig.1.8 Reduced Speed Area

1.8 Traffic Modelling

After the completion of infrastructure modelling, the travelling of vehicles has to be specified on the infrastructure and their routing also. Vehicles and pedestrian classes are as shown below according to the VISSIM software.

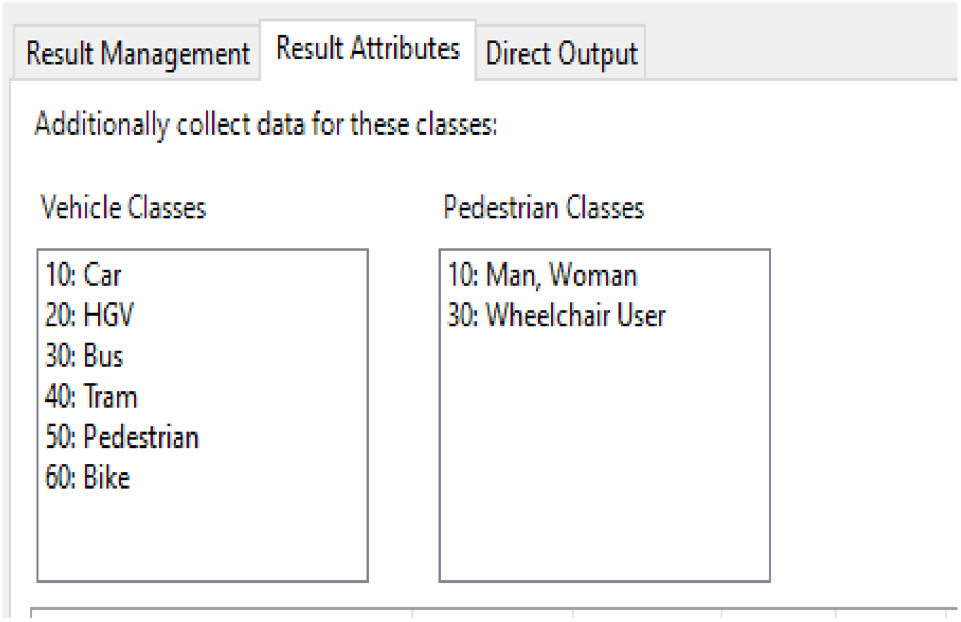


Fig.1.9 Class of Vehicles and Pedestrian

Routing is also necessary for vehicles to show where vehicles are moving or in which direction especially on an intersection.

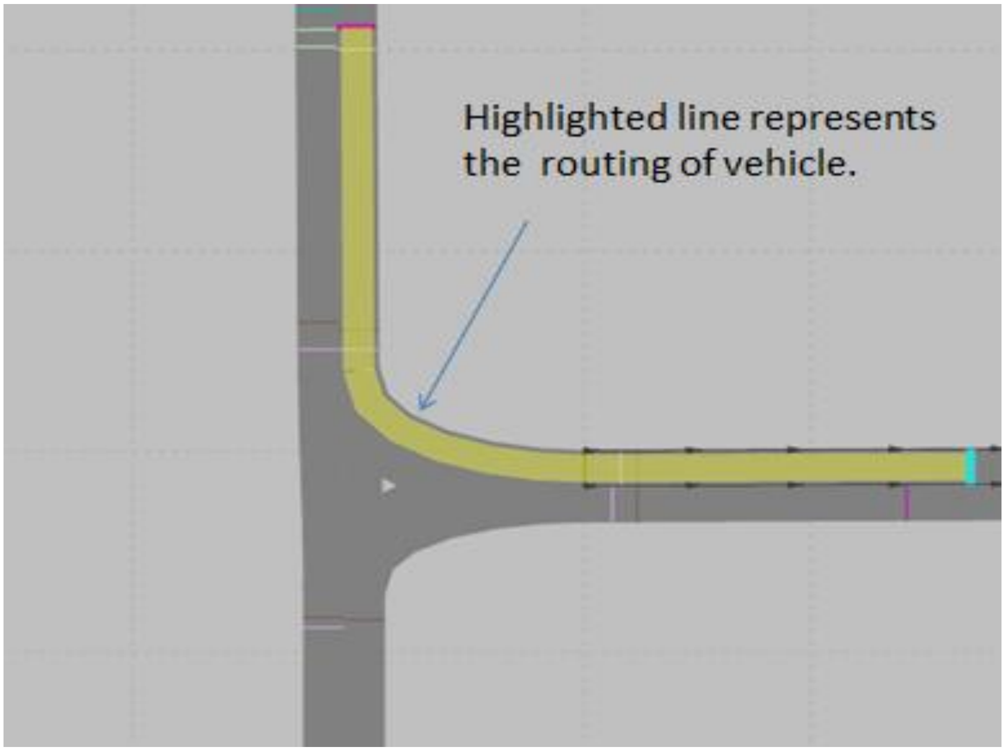


Fig.1.10 Routing of Vehicle

1.9 Traffic Control

1.9.1 Unsignalised Intersection

Priority rules are preferred in the unsignalised intersection and it implements on every condition where vehicles on altered connectors and link distinguish one another. Because of the flexibility of the primacy process, several national rules can be debated. VISSIM has a feature that allows to have the appropriate conversions done automatically. A stop line designating a waiting place for cars with small movements is included in the precedence regulations. (vehicle 2 in fig.1.11). If a vehicle from the large movement (vehicle 1) is within the leeway region, the minor vehicle will check on the stop line. A portion of the headway area begins shortly before the two movements converge. The positioning will be manually set. Furthermore, the minor vehicle determines if a large vehicle will arrive at the dispute sign in the shortest time possible if driving at its current pace. Vehicles would only stop at intersections with a yield sign when they were in the headway area or inside the disparity time zone.

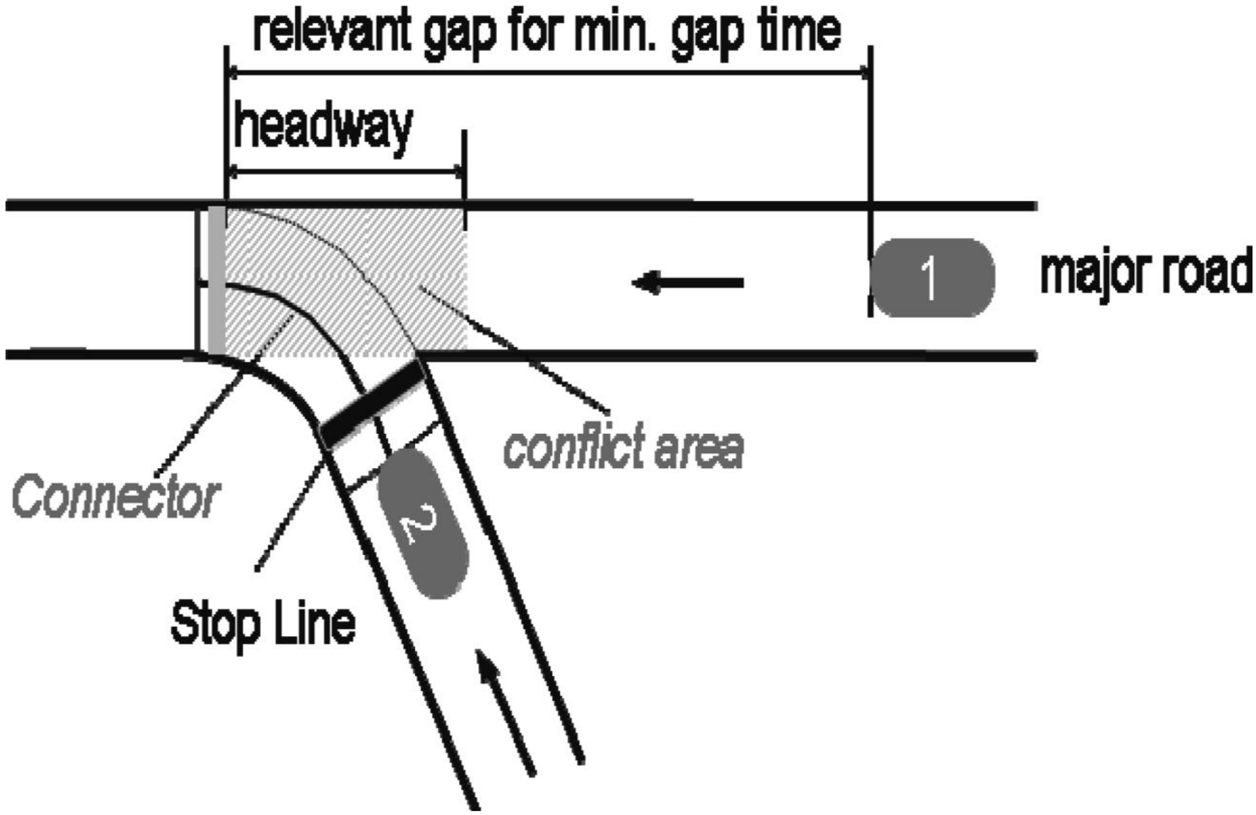


Fig.1.11 Priority Rule Concept

1.9.2 Signalised Intersection

There are several formulae for estimating queue length, delays, and the number of pauses for a signal with a steady time. To account for the chaotic impacts of vehicle appearances as well as the signal-to-vehicle-appearance feedback mechanism, microsimulation is employed for adapting and actuating signal regulation. This software, known as VISSIM, has a programming language similar to Pascal or C, as well as traffic engineering functions.

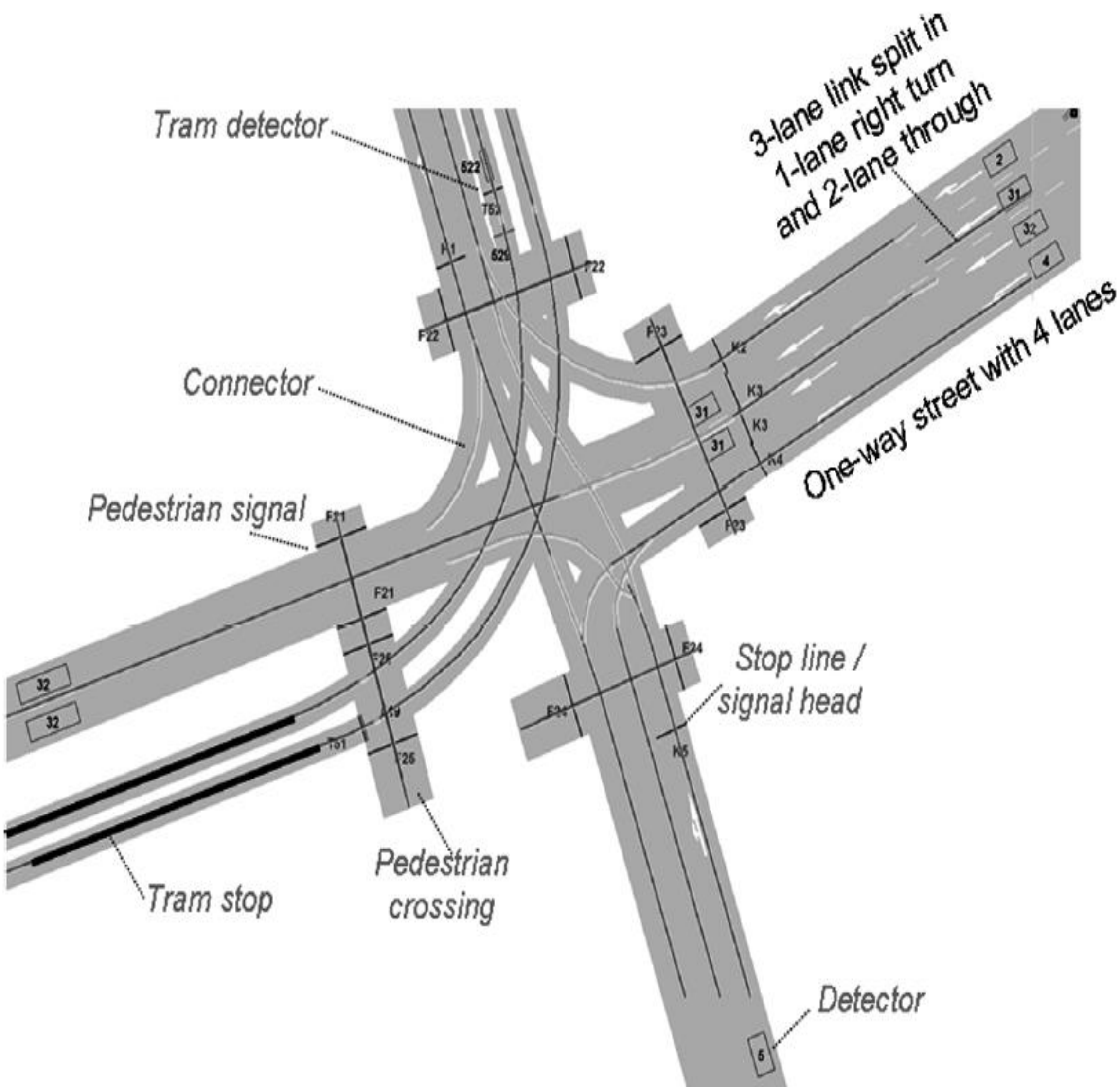


Fig.1.12 Tram tracks converge at a signalised intersection

1.9.3 Data Output

There is a function that allows you to generate film clips in the AVI format that may be utilised to communicate a project concept, and automotive movements may be animated in 3D or 2D.

Fig.1.13 3-D model of a simulated metropolitan crossroads

For better depiction, background mapping abilities with CAD drawings and aerial images should be used. Google Sketchup may be used to import more architectural models. The stimulating traffic may be converted to Autodesk 3DS max. software for more enhanced virtual reality depiction.

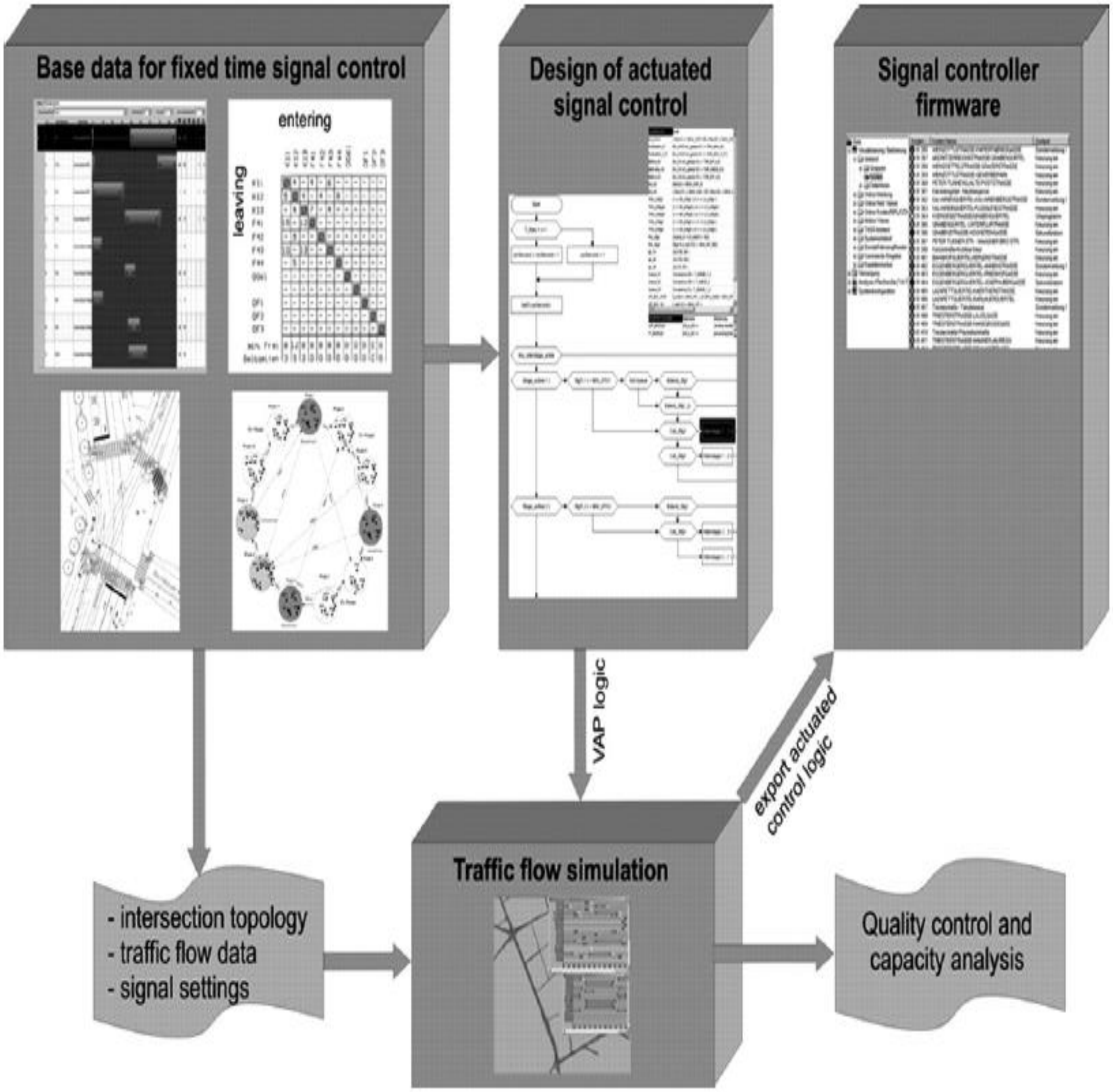


Fig.1.14 Vehicle-actuated programming to model actuated signal control (VAP)

There are several methodologies of effectiveness (MOEs) mentioned. Travel duration, delay, stops, lines, density, and speed are all common MOEs. The capacity to assess and reveal the MOEs necessary to fix the issue aids the decision-making process. The user determines how, where, and when data from a simulation is used. Data may be condensed for any time frame and intermediate within that time frame, at any spot along any route in the network.

At a crosswalk or for the entire circuit and summed by any mode combination or particular type of vehicle. Any specific vehicle's data might also be given. Records are saved in ASCII or database formats, and they're seamlessly prepared with applications like Excel or Microsoft Access. Several MOEs can also be imported into VISUM, a transportation planning programme, for detailed visualisations.

CHAPTER-2

LITERATURE REVIEW

2.1 General

Several studies have been conceded out to identify the queue length, delays of vehicles mostly on an intersection, roundabout, ramp and to find out the comparison between different simulation softwares.

Shaaban and Kim (2015) compares two simulation tools i.e. Sim Traffic and VISSIM on their performance in modelling triple, dual lane roundabouts under different conditions such as proportion of left turning movement, volume of traffic and proportion of truck in traffic flow. The result shows that there was no such difference in the values but in case of high volume of traffic VISSIM showed higher average delays as compared to Sim Traffic.

Chitturi, et.al. (2013 VISSIM, a typical system simulation platform, was used to study autonomous junctions. A reservation-based crossover device system known as Autonomous control of Urban Traffic (ACUTA) was created and implemented in VISSIM using VISSIM's external driver model, and ACUTA's ethical leadership was analysed using VISSIM's convenient evolution tools. The analysis reveals that ACUTA operated with a good precision when traffic volume of the approach was low when traffic volume was big. All of these findings indicated that ACUTA was well throughout the VISSIM.

Malim, et.al. (2019) The goal was to use any simulation programme to model the traffic flow at the intersection of Persiaran Kayangan and Persiaran Permas in Section 7 of Shah Alam. The model was created to determine the optimal timing of traffic green lights in order to reduce average time at the junction and alleviate traffic congestion. The best green time of lights at the junction was 75 seconds, followed by 130 seconds, 100 seconds, and 120 seconds, with the lowest average duration being 55.65 seconds.

Gallelli and Vaiana (2008) uses simulation software VISSIM and provide result of a long survey conducted on an ample range of roundabout scenarios. Every case describes a fixed roundabout phenomenon using following variable: minimum headway, minimum gap, priority rules etc. The results showed interesting relation between stop-line delay, parameter of simulation coding and geometric variable. A strong dependence of the stop-line delay from the value of the time gap assumed.

Saleem, et.al. (2014) Microsimulation was used to estimate the intersection's safety. Accidents are infrequent occurrences, and crash statistics cannot account for all of the potential contributing causes. Because traffic conflicts occur more frequently than accidents, utilising traffic conflicts to evaluate safety can help solve this problem. The results revealed that utilising simulated conflicts to estimate junction safety performance is a practical and reliable method.

Tianzi, et.al. (2013) compare and contrast two simulations the results of the Signalized and Unsignalized Intersection Design and Research Aid (SIDRA) and VISSIM are based on real-world traffic data from Xianyang's west wenhua and Changchun roads. The results suggest that VISSIM produces more accurate results, whereas SIDRA is easier to use.

Zhandong, et.al (2016) Using simulation in VISSIM software, control variables and dichotomy are used to derive the thresholds when cars queuing begins at the off-ramp. Different critical traffic volume thresholds can be established depending on the control mode. The experiment location in Fuzhou is the shoushan crossroads of the south second ring expressway. On account of the many stages of the complete zoning map, simulated comparison analyses are given with various control modes. The results reveal that the best control methods are non-control mode at the free flow stage, congestion mode at the congestion stage, and amble mode at the amble level. Second, induction control is used, and main road vehicles have precedence or the off-ramp is closed at the most congested stage.

Zhou and Huang (2013) The research chose a signalised junction and ran traffic simulations in VISSIM using field traffic data. The surrogate safety assessment model (SSAM) was then used to examine the vehicle's output trajectory file in order to identify simulated conflicts. The speed limit was dropped from 60 km/hr after certification and calibration. up to 50 km/hr When analysing the simulated conflicts under different speed restrictions in the VISSIM simulation model, it was discovered that the intersection's safety performance increased after the speed restriction was reduced.

Fellendorf and Vortiscg (2001) This study demonstrates the feasibility of verifying the microscopic traffic flow simulation model in VISSIM on both a microscopic and macroscopic level. VISSIM employs a psychophysical automobile following model, resulting in extremely realistic driving behavior. The sophisticated model allows for a large number of model parameters to be changed using data from driving tests, but it also needs them. As a consequence, the results reveal that a simulation tool based on a psychophysical car following model can simulate traffic flow quite realistically under a variety of real-world scenarios.

Lownes and Machemehl (2006) investigate and compare the results, that whether the impact on capacity of modifications to the behavior parameter of Vissim driver is sensitive to the values of other parameters.

Bloomberg and Dale (2000) compare two most popular simulator i.e. VISSIM and Corridor Simulation (CORISM) on technical basis and results showed that VISSIM & CORSIM are more similar to each other than they are identical. Both models generate extensive tabular and animated graphical output. The significant distinction between the models was in vehicle and driver behavior, particularly in the scenario of automobile following and gap acceptance.

Zhou, et.al. (2010) It is proposed to employ a two-stage calibration procedure based on experimental optimization. To test its performance, six groups of data from three junctions are surveyed and imposed for validation and calibration using the approach described above, which involves integrating a surrogate safety analysis model (SSAM) with vehicle trajectories exported from VISSIM. The results demonstrated that while the experimental optimization approach is theoretically suited for diverse traffic, conflict mechanisms between walkers, motorbikes, and bicycles varied significantly.

Istiqomah and Qidun (2018) describe the coupling scheme between VISSIM and Mat lab which can be performed and integrated in real time simulation. The research succeeded to store and read the outcome in .txt file. These outcomes were the no. of vehicles that enter and exit on intersection and also the queue length of vehicles.

Lee, et.al. (2018) aim's to investigate effectiveness and possible causes of countermeasures by using comparison sites or before and after studies and in all cases it shows a reduction in red light area (RLA) frequency. The largest reduction is done by RLR camera (-60%) in crossing conflicts and in the other case where yellow signal interval is increased shows reduction of 12.8% of rear-ends conflicts.

Dabiri and Abbas (2018) For the production of arterial traffic signal timing parameters, an optimizer particle swarm optimization (PSO) technique was utilised. VISSIM is used to calculate measurements of traffic arterials that are controlled by timing plans. It's written in MATLAB and controlled using the VISSIM COM interface. When comparing the suggested approach timing plans to those generated by VISTRO, a signal optimization programme, it is clear that the suggested technique outperforms and is promising for diverse traffic conditions.

Paul, et.al. (2018) Provides a methodology for calibrating the VISSIM model for unsignalized intersections under diverse traffic conditions, and the results demonstrate that the optimal values and calibrated parameters are attained by lowering the error between the field gap time and simulated. The calibrated model is tested for other time periods not included in the calibration using gap data, and the observed error is less than 5%. As a result, the suggested model may be used for the site's entire day traffic as well as sites with similar traffic and road characteristics.

2.2 Summary of Literature Review

On the basis of these literature Reviews we came to following conclusion:

- There are many simulation softwares for traffic engineers these days and while comparing them they all give data which can be utilised for the traffic safety mostly on an intersection, ramp and roundabouts.
- Among all the other simulation softwares VISSIM is widely adopted reason for that is that it give more accurate results as compared to other software although VISSIM is complex to operate as compared to others.
- Main parameters for traffic are delay vehicles, Queue length and congestion which we can easily find by replicating the model with the help of data and found out the parameters without putting the life of people in danger.

2.3 Objective of the study

1. To identify the problems occurring with the increasing traffic on an intersection {Dadour and Una-Jahu, Nerchowk rd. (NH-21),H.P} through VISSIM.

2. To overcome the identified problems and conflict points using PTV VISSIM.

3. To compare the existing situation with simulation results of PTV VISSIM & give solution.

2.4 Scope of the study

- In this study real world data of an unsignalised intersection is taken and with the help of data replicated the model in VISSIM by using network elements of VISSIM and will find out the problems occurring on the basis of parameters (delay vehicles, Queue length and conflict points).
- This is pandemic year 2020 (COVID-19) so real field data is less so, increase its value by 30% and then run the simulation. Compare the parameters and see what it will affect on the parameters when vehicle volume is increased and if volume of vehicle lies or follow Warrant 1 (IRC: 93:1985) or having conflict points then provide traffic signals in VISSIM and run simulation again .At, last compare all the three simulations and try to give solution for the identified problems.

CHAPTER-3

METHODOLOGY

3.1 General

This chapter describes the simulation run in depth and aids in the achievement of the project's objectives. Three simulations will run in VISSIM and their output will be compared on the basis of traffic parameters (Delay vehicle, Queue length). Data is taken from the unsignalised intersection {Dadour and Una-Jahu, Nerchowk rd. (NH-21)} which was less as per expectations due to the COVID-19, so in second simulation run real value is increased by 30% and as data falls in warrant 1 so in third situation simulation will run with signalized intersection. At last all three will be compared.

3.2 Data collection

To replicate any model in VISSIM basic requirement is data which is collected from the intersection {Dadour and Una-Jahu, Nerchowk rd. (NH-21)} by using videography method as it gives a permanent record of volume count, data can be cross checked and quality can be ensured (Table 3.1) and for the speed of vehicle a stretch near intersection is taken about 120 m in distance and vehicle took 10 sec. to complete the distance. Therefore using formula (1) speed of vehicle comes out to be 12m/sec. or 43.2 km/hr~45 km/hr.

$$\text{Speed} = D/t \tag{1}$$

Where:

D = Distance

T = Time

Time A.M / P.M	NH-21(Major road) Veh./hr.	Dadour (Minor road) Veh./hr.
9:00-10:00	640	143
10:00-11:00	597	205
11:00-12:00	780	180
1:00-2:00	778	190
1:00-2:00	670	210
2:00-3:00	728	201
3:00-4:00	688	185
4:00-5:00	780	180
5:00-6:00	798	207
	Average approx. = 720	Average approx. = 190

Table 3.1 Volume of vehicle (Real data)

Use the average value of 720 veh./hr. (major road) and 190 veh./hr. (secondary road) based on the data (Minor road). This data is less as per expectations due to the Pandemic (Covid-19) so, for the theoretical data this real data is increased by 30% and then the theoretical value adopted is 936~940 veh./hr. (Major road) and 247~250 veh./hr. (Minor road). For the third simulation the data will be same as in 2nd simulation but as this data lies in warrant 1 so traffic signal need to be design and the intersection will be having 3 phases shown in fig.3.1 below.

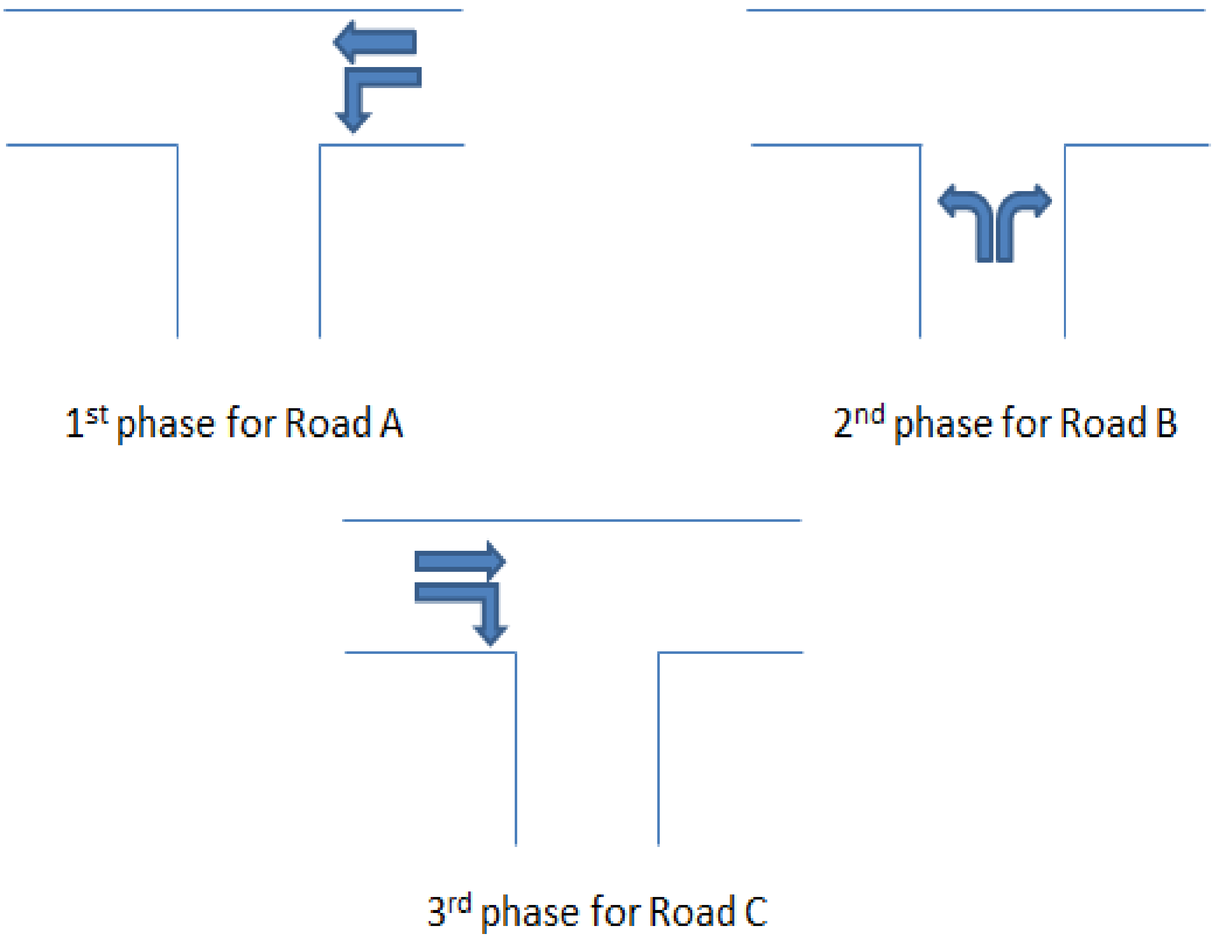


Fig.3.1 Phases for signalized intersection

Data: T-shape unsignalised intersection, Total 3 phases

Major street width (Road A & Road C) = 7m (2 lane)

Minor street width (Road B) = 7m (2 lane)

Volume of Road A = 940 veh./hr.

Volume of Road B = 250 veh./hr.

Volume of Road C = 940 veh./hr.

Pedestrian walking speed = 1.2m/sec. (from IS: 93:1985)

Step 1: Time for pedestrian crossing

For Road A = Width of lane / Pedestrian walking speed + 7 (2)

= 3.5/1.2 + 7 = 9.91~10 sec.

For Road B = Road C = 10 sec.

Step 2: Minimum Green time for traffic

As minimum pedestrian crossing time for Road A is 10 sec. means min. green time for road B traffic is 10 sec. and same for road A & Road C.

Green time Road A & C = (volume of A/volume of B)*Min. green time road A (3)

= (940/250) * 10 = 37.6~38 sec.

Adding Clearance amber and initial amber of 2 sec. for each phase (total 3 phases). So, and total cycle time = (2+10+2) + (2+38+2) + (2+38+2) = 98 sec. According to the IS code cycle time is always in multiple of 5 so new cycle time = 100 sec. The extra 2 sec. can be apportioned to the green time of Road B.

Signal Timing	Initial Amber	Green Time	Clearance Amber	Red Time	Cycle length
Major Street A & C	2 sec.	38 sec.	2 sec.	58	100 sec.
Minor Street B	2ec.	12 sec.	2 sec.	84	100 sec.

Table 3.2 Signal Timing

Step 3: Examine the cars that came during the green stages for clearance

Acc. to IRC: 93:1985 it is assumed that on each approach first vehicle will take 6 sec. to start after the stop on signal and all other vehicles behind that will constant headway of 2 sec. each.

No. of vehicles per lane per cycle of 100 sec. for Road A & C = 940/100 = 9.4~10

Minimum green time for Road A & C on above assumptions = 6 + (10-1) 2 = 24 sec.

Therefore, 24 sec. is less than the calculated green time for A & C which is 38 sec. and safe.

No. of vehicles per lane per cycle of 100 sec. for Road B = 250/100 = 2.5~3

Minimum green time for Road B on above assumptions = 6 + (3-1) 2 = 10 sec.

Therefore 10 sec. is less than the calculated green time for B which is 12 sec. So, it is safe.

Step 4: Check for optimum cycle length by Webster's Equation

$$C_0 = \frac{1.5L+5}{(1-Yi)} \tag{4}$$

Where,

C_0 = optimum cycle length

L = Loss of time in one cycle = 2N + R, R is generally 16 sec.

N = No. of phases

R = Total red time

$Y_i = Y_A + Y_B + Y_C$..............

To find Green signal use formula (4) as shown below:

$$G_A = \frac{Y_a(C_0 - L)}{Y_i} \tag{5}$$

Where,

G_A = Green time for phase 1 and similar for other phases.

$Y_a = N_a / S_a$

N_a = Vehicle accommodated on Road A in 1 hour/lane

S_a = Saturated volume of vehicles accumulated on road A per hour per lane given in IRC:93:1985.

L= 2N+R = 2*3+2(amber time for each phase)

L = 6+2(2+2+2)

L = 18 sec.

$Y_a = N_a/S_a$ = 720/1890 = .38 = Y_c

$Y_b = N_b/S_b$ = 250/1890 = .13

Y_i = .38+.13+.38 = .89

C_0 = 1.5*18+5/1-.89 = 290 sec.

Optimum cycle length comes out to be 290 sec. which is not suitable for the signal design because it will delay vehicles so for simulation Minimum 100 sec. is adopted so; table 3.2 values will be followed for the third simulation traffic signal timing.

3.3 Steps for Replicating Model in VISSIM:

STEP 1: First step in VISSIM is to create link and connectors which are the basic elements to design any road or intersection and model should always designed to the scale by tracing manually from the smart map.

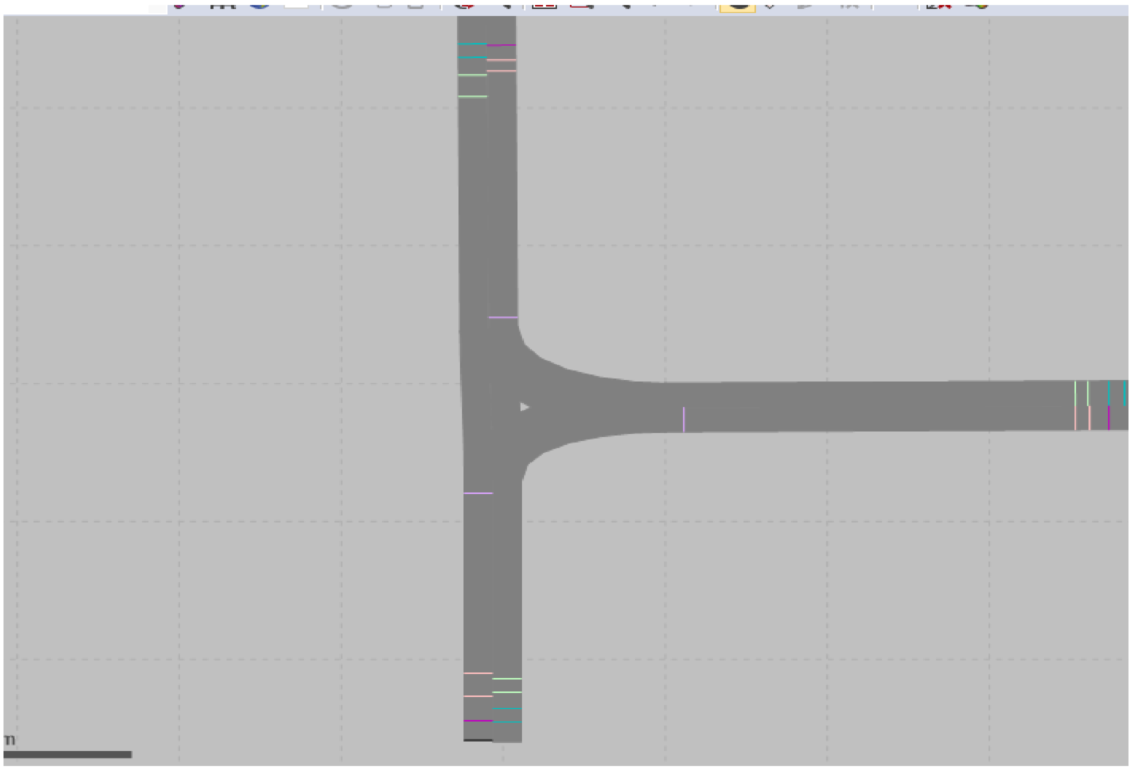


Fig.3.2 Intersection model in Vissim

STEP 2: As vehicles will turn on the intersection so there speed should be less, so for that case provide reduce speed area and use this option from the Network objects bar on left side of VISSIM and then select area where vehicle speed need to be reduce. Fig.1.8 represents the reduced speed area of the intersection.

STEP 3: Select Input vehicle option from the bar, here add vehicle no. on the lane and there are three lanes where data (Real) needs to be add which is already collected and shown in Fig.3.3.

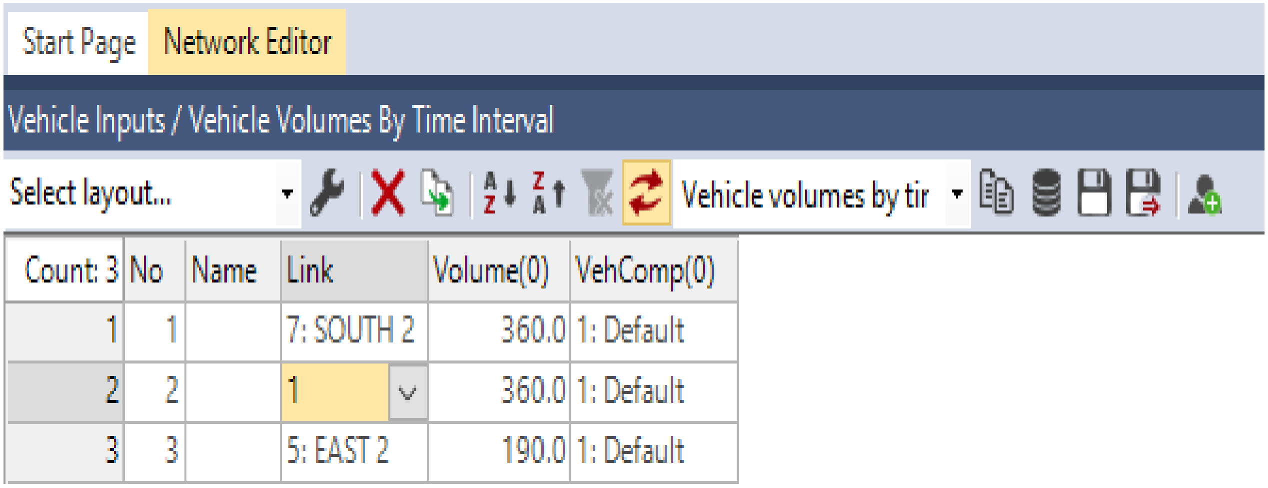


Fig.3.3 Vehicle input in Vissim

STEP 4: After vehicle input routing of vehicle is also necessary. It is also done from the bar with option vehicle routing. With the help of this option select the route of vehicle that where they will move and in dialogue box fill relative flow and also that how much vehicle will move in that route. The relative flow of traffic of the intersection is shown in Table 3.3 and line diagram in Fig.3.4.

Sr. no.	**Time A.M/P.M**	**North to East Veh./hr.**	**South to East Veh./hr.**	**East to South Veh./hr.**	**East to North Veh./hr.**
1.	9:00-10:00 A.M	88	82	91	105
2.	10:00-11:00	91	92	98	102
3.	11:00-12:00	82	88	98	105
4.	12:00-1:00	98	76	91	110
5.	1:00-2:00	102	81	98	88

6.	2:00-3:00	87	78	108	101
7.	3:00-4:00	78	82	109	104
8.	4:00-5:00	80	81	108	105
9.	5:00-6:00 P.M	149	75	110	119
	Average	=95 approx.	=80 approx.	=100 approx.	=105 approx.

Table 3.3 Relative flow of vehicle

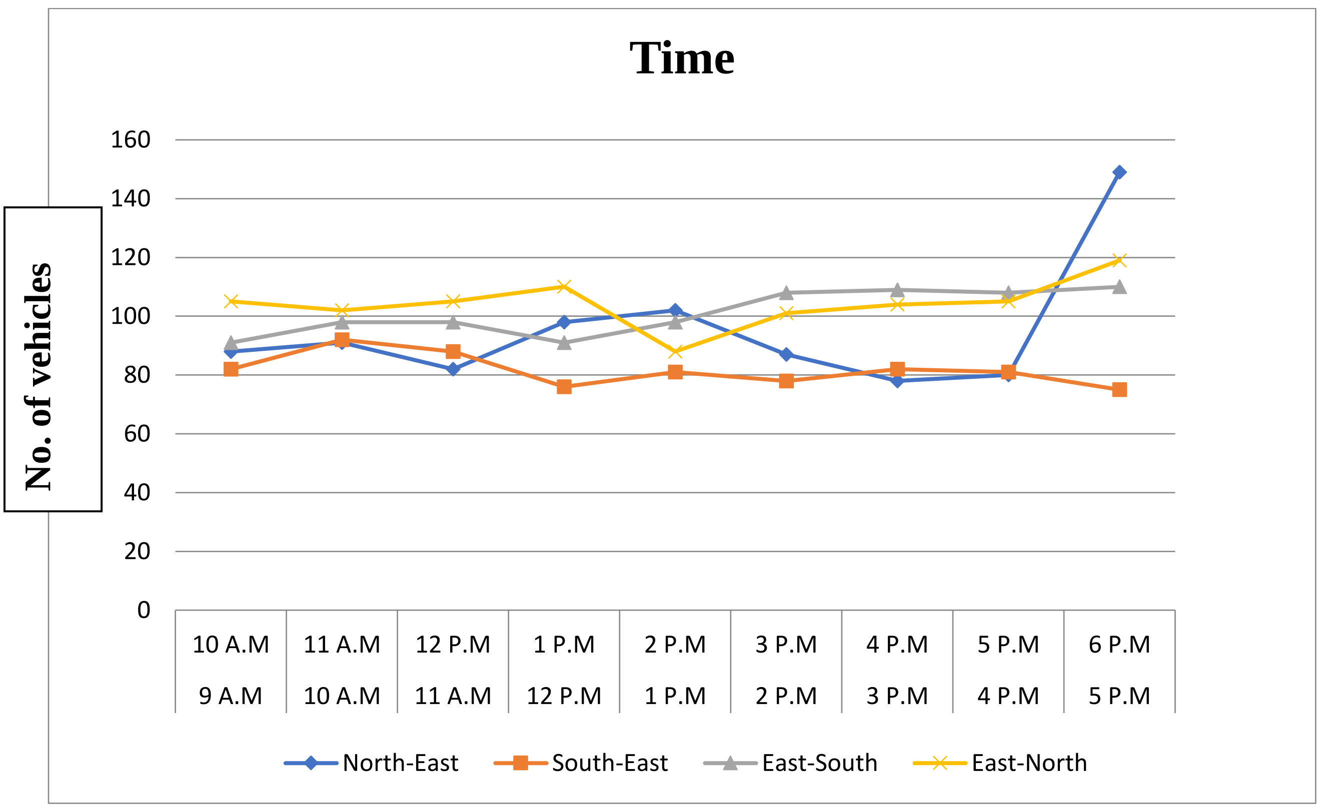
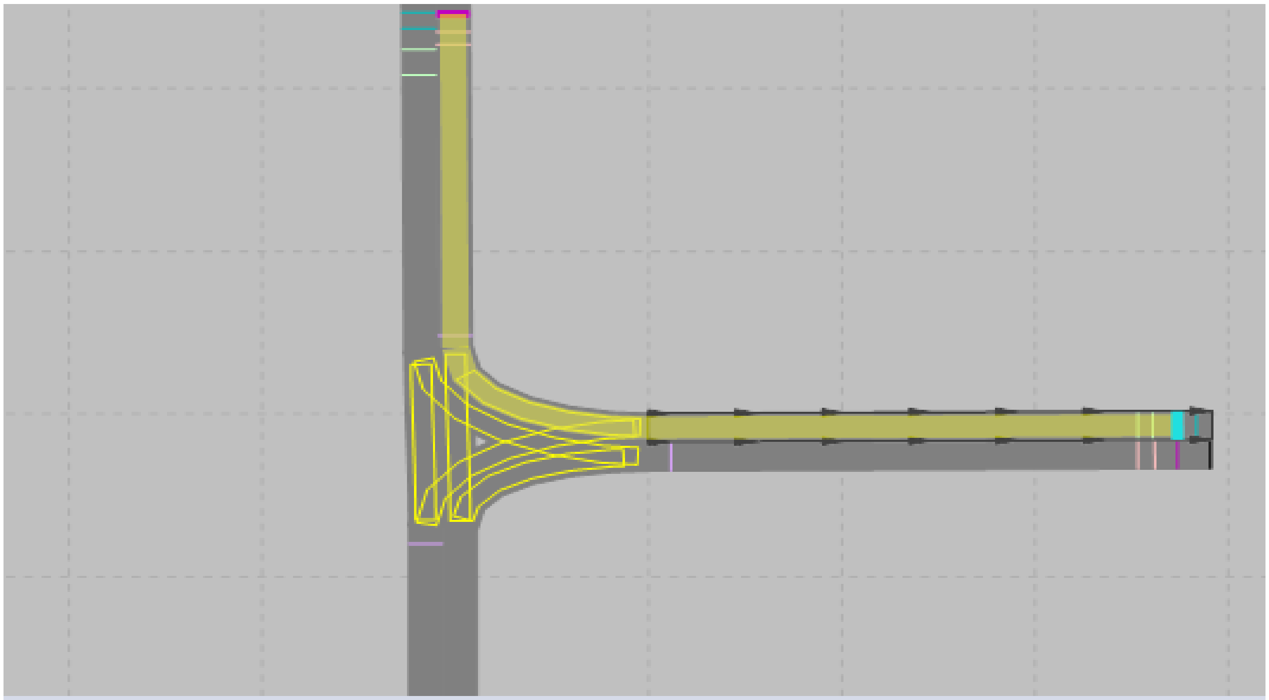


Fig.3.4 Vehicle routing and relative flow line diagram



Count: 6	VehRoutDec	No	Name	Formula	DestLink	DestPos	RelFlow(0)
1	1	1			3: EAST 1	54.787	95.000
2	1	2			6: SOUTH 1	35.468	250.000
3	2	1			6: SOUTH 1	33.504	110.000
4	2	2			2	41.767	110.000
5	3	1			2	39.803	250.000
6	3	2			3: EAST 1	56.753	95.000

Fig.3.5 Vehicle routing and relative flow data in vissim

STEP 5: After putting all data which is required for the VISSIM simulation find out the delay vehicles and queue length of vehicle by running the simulation.

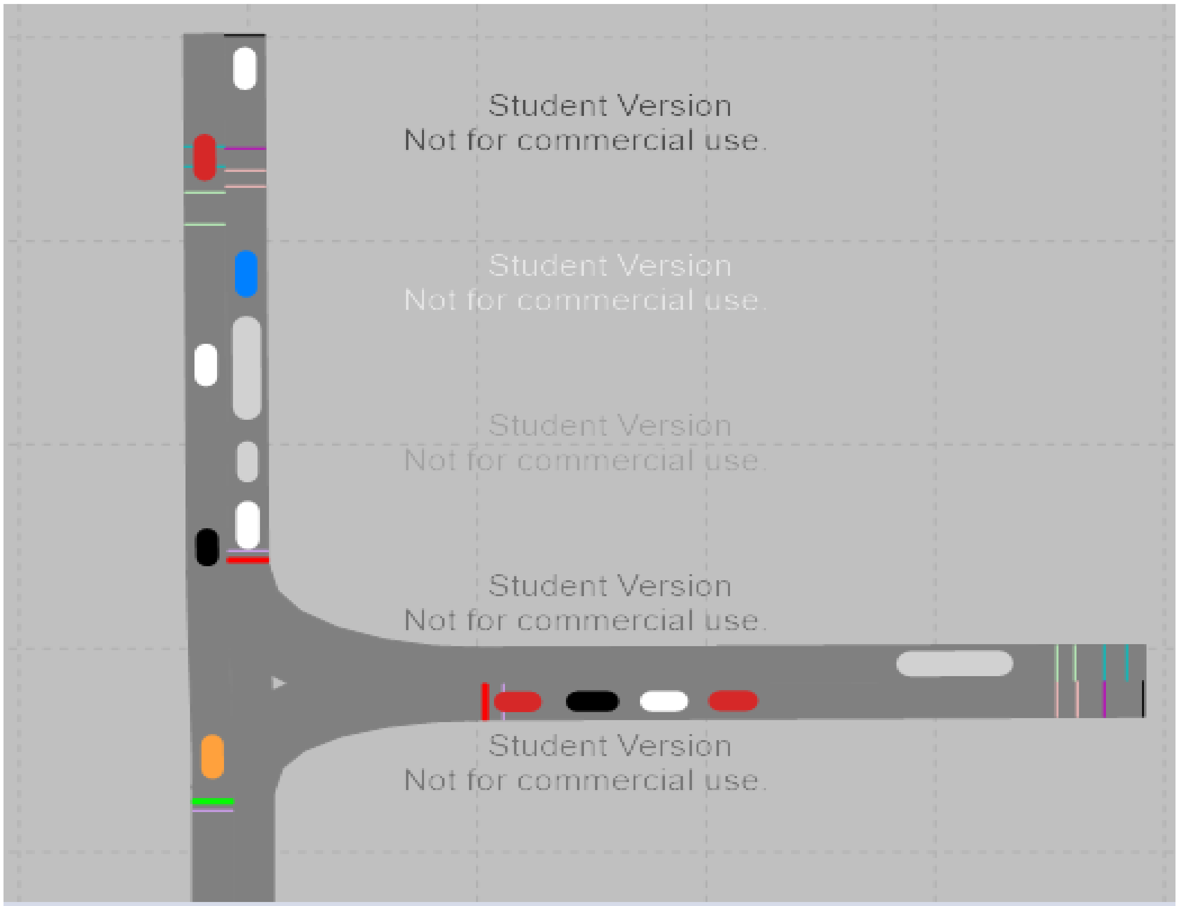


Fig.3.6 Simulation in vissim

STEP 6: In First Simulation the data used was less due to the pandemic (covid-19) but in second simulation increase that value by 30% so that it can follow warrant 1 (Min. Vehicular Volume) shown in IRC:93:1985 & will also help in third simulation. Rest all the steps are same as shown in first simulation process.

STEP 7: For the third simulation it need traffic signal timing which is shown in table 3.2 and will input that data in vissim shown in fig.3.7 below. And rest all steps are same as for 2nd simulation even the vehicular data which is used.

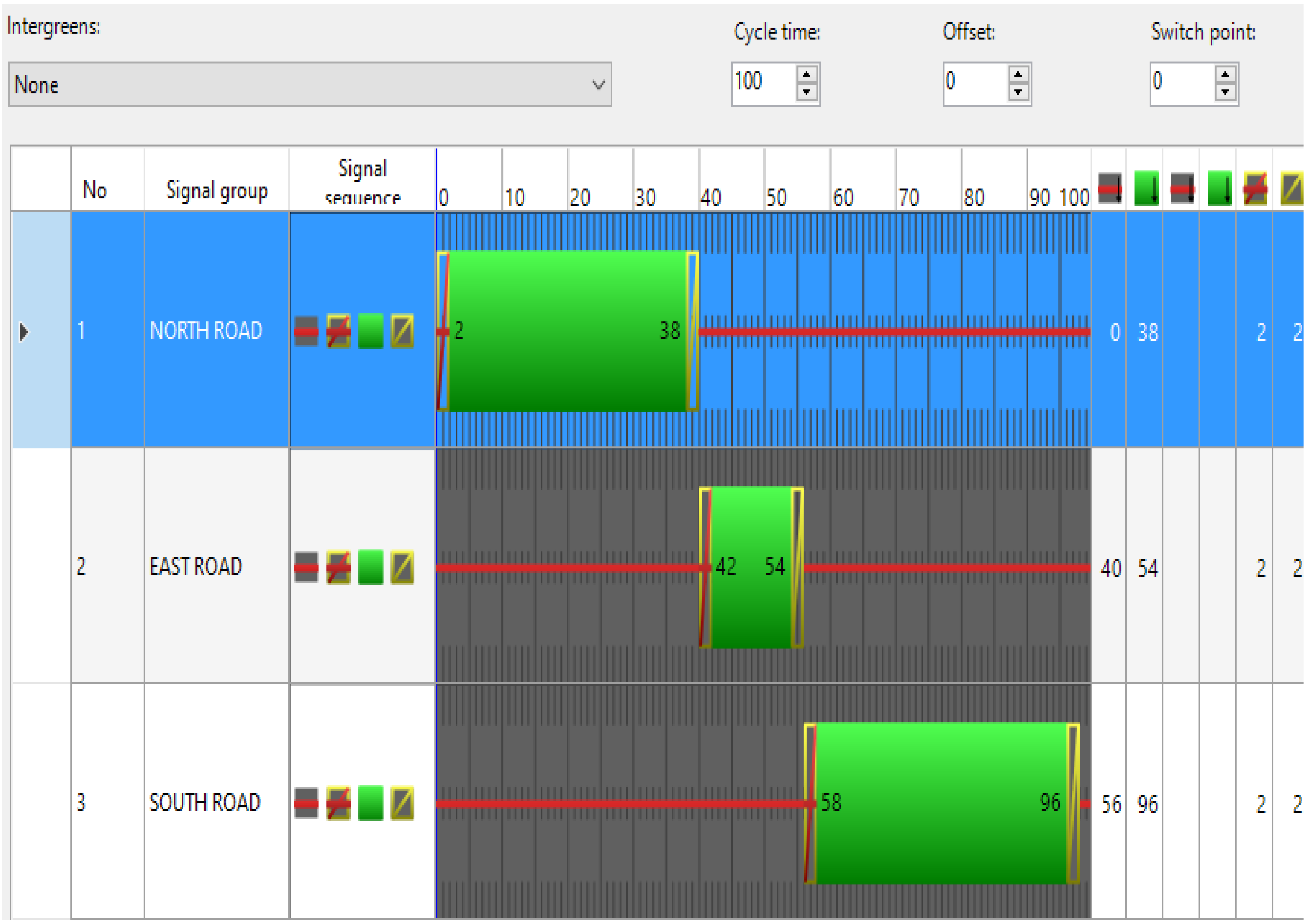


Fig.3.7 Signal timing in vissim

CHAPTER-4
RESULT AND DISCUSSION

4.1 RESULT

Three simulations are analyzed on an unsignalised intersection {Dadour and Una-Jahu, Nerchowk rd. (NH-21)} on the basis of traffic parameters (delay vehicles and queue length).

Delay Measurement and Queue count (1st simulation)

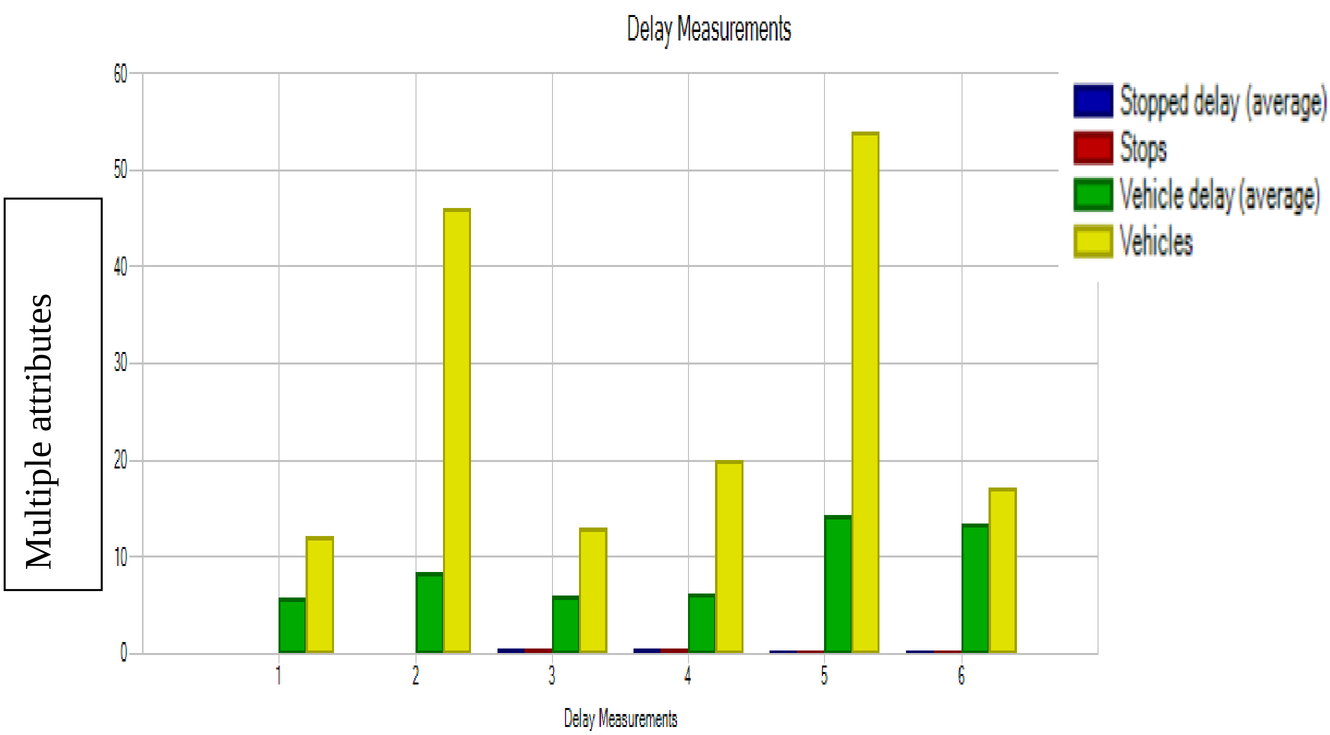


Fig.4.1 Delay Measurement (1st simulation)

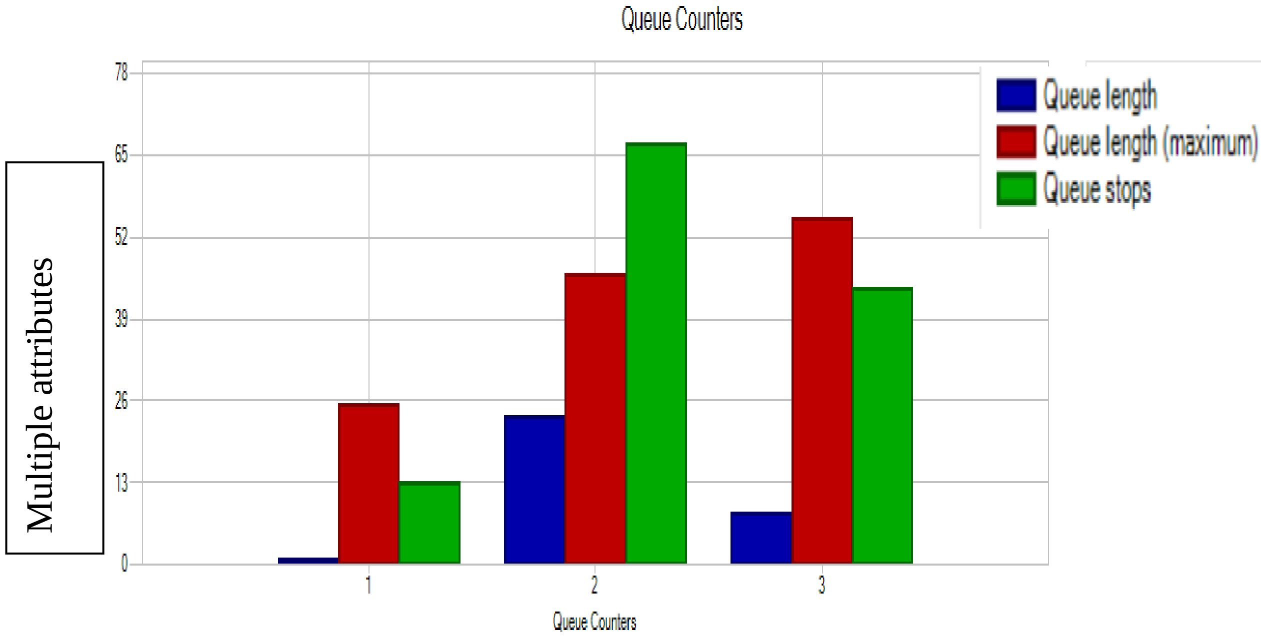


Fig.4.2 Queue count (1st simulation)

Delay Measurement and Queue count output (1st simulation)

TIMEINT	STOPDELAY (sec.)	STOPS (no.)	VEHDELAY (sec.)	VEHS
0-3600	0	0	5.66	12
0-3600	0	0	8.25	46
0-3600	0.52	0.46	5.88	13
0-3600	0.4	0.45	6.04	20
0-3600	0.06	0.06	14.28	54
0-3600	0.06	0.06	13.41	17

Table 4.1 Delay measurement output from vissim (1st simulation)

SIMRUN	TIMEINT	QCOUNTER	QLEN (m)	QLENMAX (m)	QSTOPS (no.)
1	0-3600	1	0.88	25.56	13
1	0-3600	2	23.56	46.05	67
1	0-3600	3	8.18	55.23	44

Table 4.2 Queue count output from vissim (1st simulation)

Delay Measurement and Queue count (2nd simulation increase of 30% in real data)

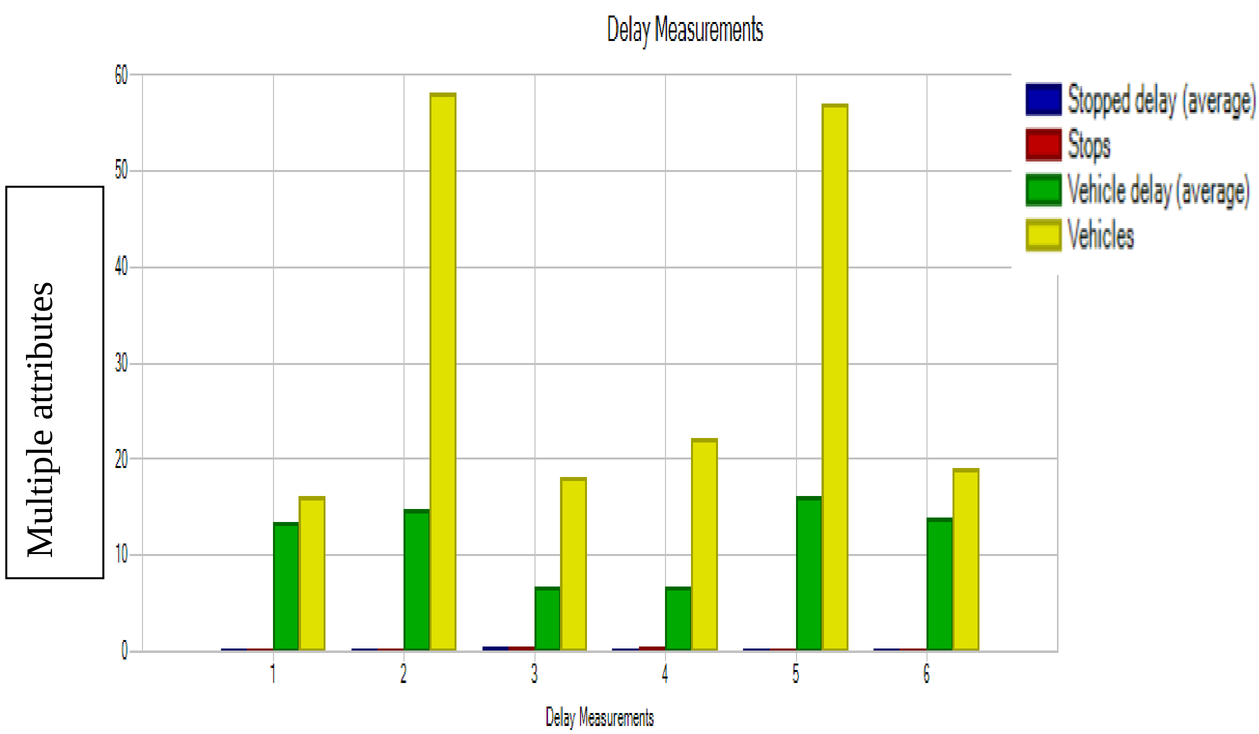


Fig.4.3 Delay Measurement (2nd simulation)

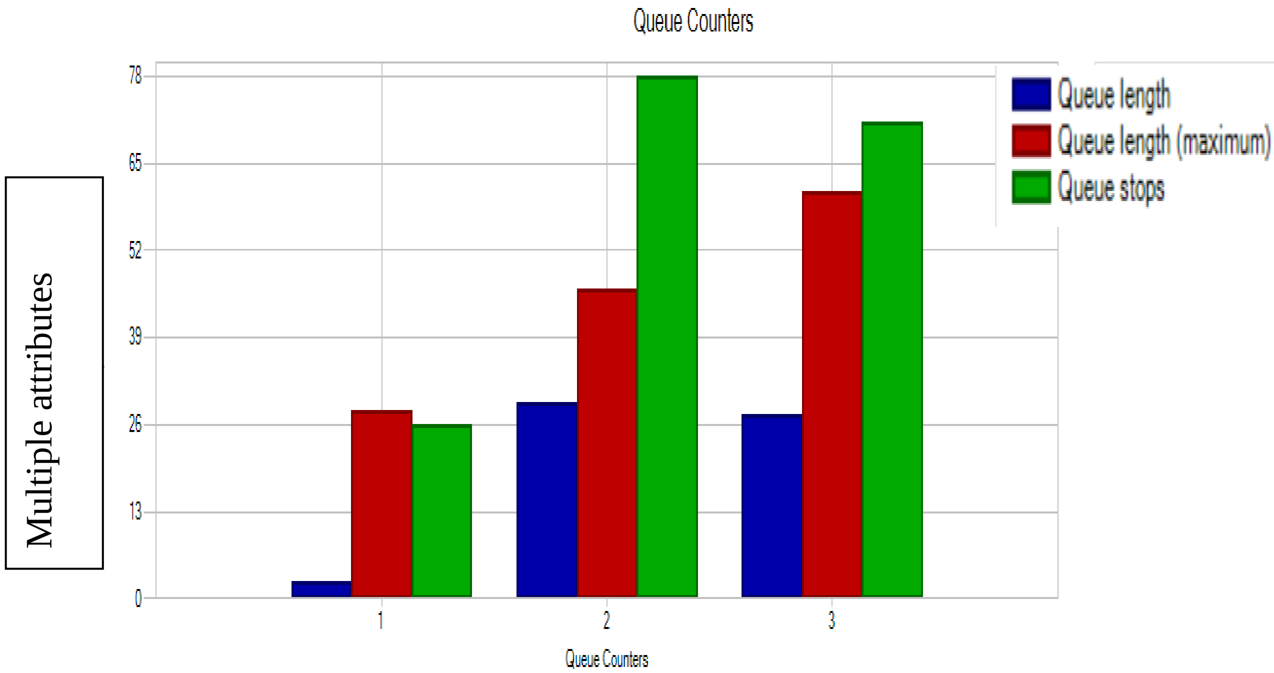


Fig.4.4 Queue count (2nd simulation)

Delay Measurement and Queue count output (2nd simulation increase of 30% in real data)

TIMEINT	STOPDELAY (sec.)	STOPS (no.)	VEHDELAY (sec.)	VEHS
0-3600	0.21	0.13	13.3	16
0-3600	0.12	0.09	14.79	58
0-3600	0.36	0.33	6.71	18
0-3600	0.23	0.36	6.71	22
0-3600	0.07	0.05	15.97	57
0-3600	0.07	0.11	13.91	19

Table 4.3 Delay measurement output from vissim (2nd simulation)

SIMRUN	TIMEINT	QCOUNTER	QLEN (m)	QLENMAX (m)	QSTOPS (no.)
1	0-3600	1	2.34	27.99	26
1	0-3600	2	29.31	46.06	78
1	0-3600	3	27.35	60.82	71

Table 4.4 Queue count output from vissim (2nd simulation)

Delay Measurement and Queue count (3rd simulation with traffic lights)

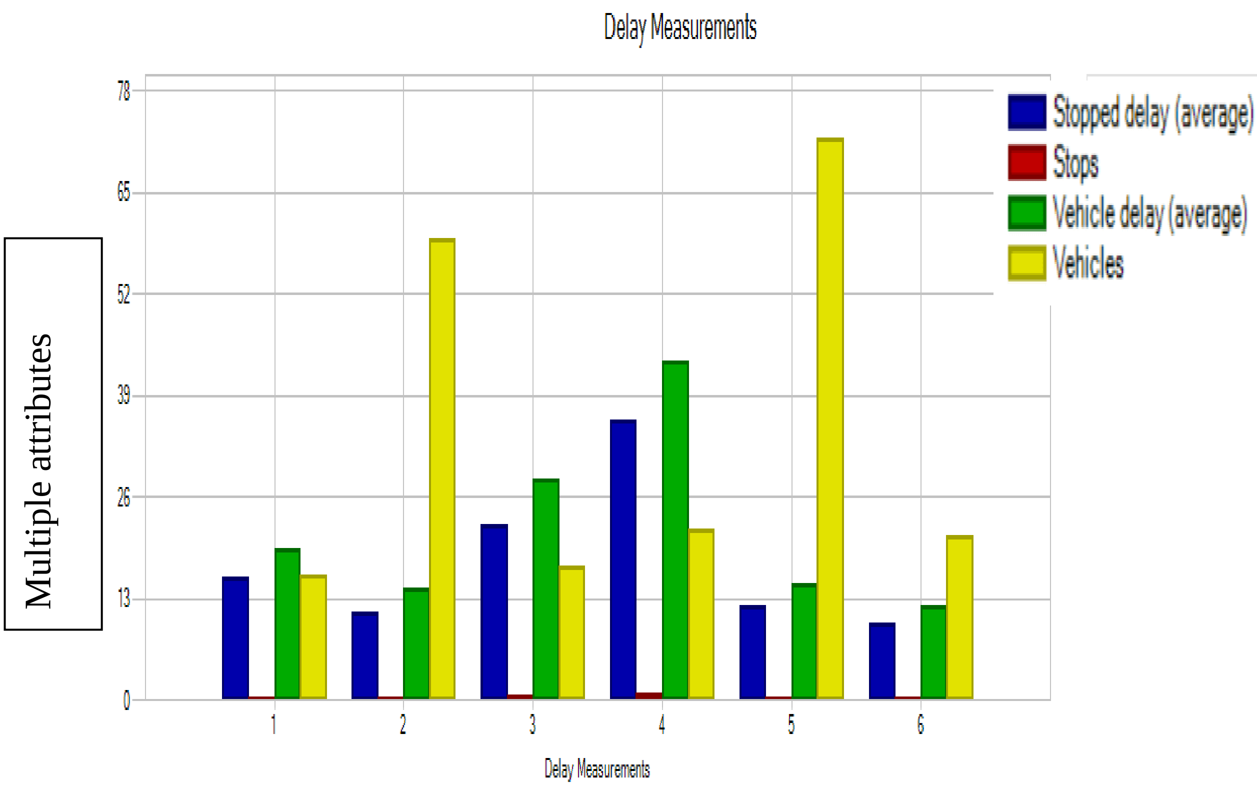


Fig.4.5 Delay Measurement (3rd simulation))

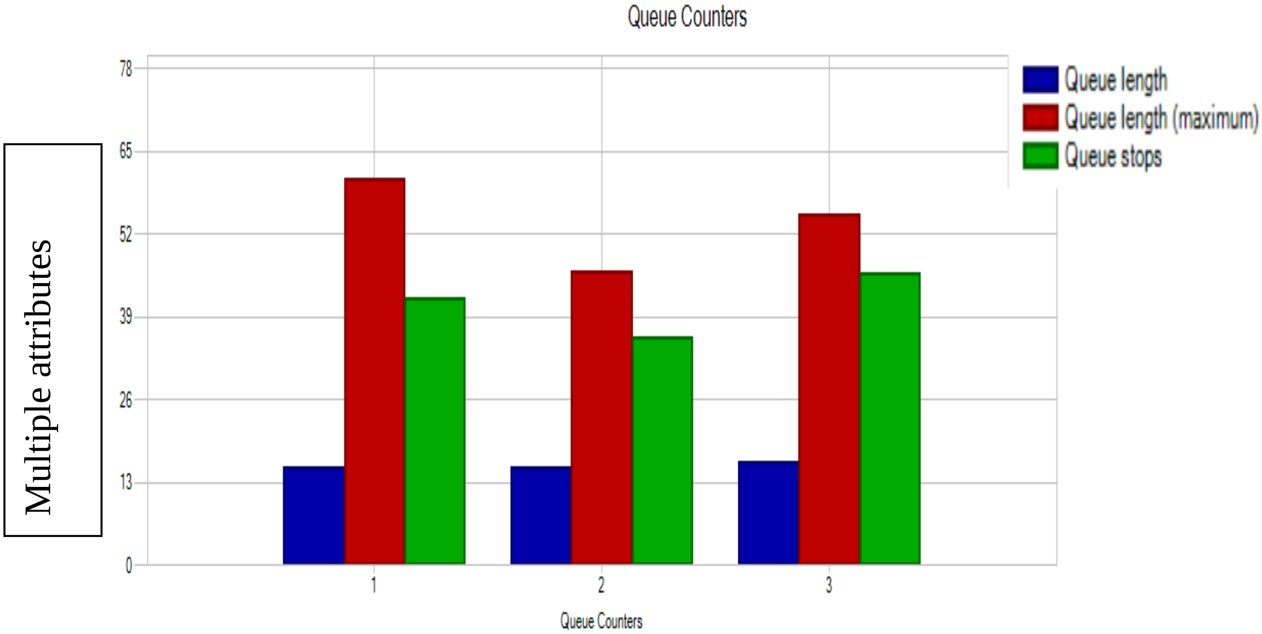


Fig.4.6 Queue count (3rd simulation)

Delay Measurement and Queue count output (3rd simulation with traffic lights)

TIMEINT	STOPDELAY (sec.)	STOPS (no.)	VEHDELAY (sec.)	VEHS
0-3600	15.8	0.44	19.36	16
0-3600	11.31	0.34	14.26	59
0-3600	22.41	0.71	28.32	17
0-3600	35.9	0.91	43.44	22
0-3600	12.2	0.33	14.9	72
0-3600	10	0.24	12.14	21

Table 4.5 Delay measurement output from vissim (3rd simulation)

TIMEINT	QCOUNTER	QLEN (m)	QLENMAX (m)	QSTOPS (no.)
0-3600	1	1.58	26.71	24
0-3600	2	15.61	46.14	36
0-3600	3	16.35	55.31	46

Table 4.6 Queue count output from vissim (3^{rd} simulation)

Results shows that with increase in vehicular data it didn’t show so much variation in vehicular delays whereas there was an increase in long queues or queue stops while comparing simulation 1^{st} & 2^{nd} data and when third simulation (with traffic lights) is done it shows that, not so much variation in delay measurement but it overcomes the queue stops while comparing 2^{nd} & 3^{rd} simulation data.

CHAPTER-5

CONCLUSION

5.1 Conclusion

The objective of the study was to identify the problems occurring with the increase in traffic on an unsignalised intersection and to overcome those problems through VISSIM. As, the traffic in India is heterogeneous and mixed in its nature, travel growth on the road will lead to vehicular delays and long queues. To study these two parameters, three simulations were done and while comparing first two simulation results, it shows that with the increase in traffic volume there was not so much variation in vehicular delays but the no. of queue stop increases as in 1st simulation queue stops on each counter were 13, 67, 44 respectively whereas in 2nd simulation result, queue stops increases to 26, 78, 71 respectively and when 3rd simulation is done with traffic signal implementation as it follows warrant 1 {(Min. Vehicular Volume) for which cycle length of 100 sec. is taken for traffic signal and shows that there was again not so much variation in vehicular delays but it reduces the no. of queue stops to 24, 36, 46 respectively and also reduce the conflict points from 9 to 3 as three phase system was used. So, it represents that with the implementation of traffic signal on intersection {Dadour and Una-Jahu, Nerchowk Rd. (NH-21), H.P} queues stop parameter can be reduced.

5.2 Future Scope of Study

Similar procedure can be used for analysing any unsignalised intersection to check the parameters (Vehicular delays and queue stops) and if it follows warrant 1 then implementation of traffic signal can be used to overcome some paramters otherwise if it doesn't follows warrant 1 or it isn't possible to implement the traffic lights then in future studies researcher can considered some other options like using slip lane, rotary intersection if land area is large, small island (tangents), increase the number of lanes and see whether these are helpful to overcome the parameters or not.

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