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Synchronization Of Traffic Signals In Chandigarh Using Simulation Modeling

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ABSTRACT

In today's traffic scenario the volume of vehicles are increasing day by day, queue lengths are increasing during peak hours and the journey time is also increased. There are two options to tackle with this situation, the first one is by altering the geometry of road like widening of roads and the second one is by optimizing the various facilities which are available on the roads. Now a days in the modern world of computers the advancement is so much that we can simulate the study area in the simulation tool and analyze the different options which are available with us to optimize the facilities which are available on the roads. One such simulation tool is VISSIM. Calibration of this simulation tool is done by identifying and modifying the four different driver behavior parameters. Here in this tool the network of the study area is preparedand optimized signal timing is obtained from another software called VISTRO. That signal timing is then simulated in the VISSIMfor obtainingthe queue length and that queue length is compared with the queue length which is obtained using the field timings to find out the best signal timings.

Keywords*: Signal Optimization, Simulation, VISSIM, VISTRO*

1. INTRODUCTION

India is a developing country there is a substantial growth in all the sectors mainly in the field of industry. People start to shift towards the urban and metropolitan areas for their needs like earning money, higher education and for other facilities. So because of this problem number of vehicles are increasing day by day and the available road facilities are not being able to cope up with the demand.

This required demand can be tackled out by creating facilities on the existing roads like widening of road but this is not the ultimate solution as this may end up in encouraging more traffic from the adjoining areas and this will aggravate the problem. Another problem with the traffic is that in India the traffic is of heterogeneous type. The traffic vehicles vary on the basis of their static and dynamic characteristics. India's traffic consist of both motorized traffic and non-motorized traffic, also they don't move on a particular lane creating congestion on road especially at the intersection.

In order to tackle this problem if the local bodies of that area come with different schemes, then there is one way to find out the optimal solution out of those schemes, the way is to implement all the schemes on road and then analyze the consequences. This is a very lengthy and complicated procedure. On the other hand if the scheme will result in a failure then it's a loss of both time and money, both the things are precious. So, we have to find some other ways in order to find out the best solution out of those schemes.

In today's world micro simulation has become an important and mostly used tool by the traffic engineers and by urban development planners to find the best solution out of different schemes. **VISSIM**is the micro simulation software in which all the geographical features of the road can be modeled. Then that model will be calibrated and validated in order to match the model with the field conditions. In order to reduce the congestion at the intersections, a stretch consisting of three to four consecutive coordinated signal intersections will be selected and modeled in the

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VISSIMsoftware and then the field data will be used in the **VISTRO** software. This software will give the optimum signal timings. Then use that signal timing in the modeled stretch in **VISSIM**for simulation and evaluate the same for queue lengths. The results will be compared with the results obtained when the field data was simulated in the software. In this way congestion at the intersections can be reduced by using the optimal signal timings given by **VISTRO** with reduced queue lengths and reduced travel time.

2. STUDY AREA

As the main objective of this study is find out the optimal signal timing for the consecutive coordinated signals. So the stretch selected should have at least three consecutive signalized intersections. For this, a stretch on the PurvMarg in the city Chandigarh is selected. The selected stretch has four consecutive signalized intersection. The selected stretch is the only and main link for connecting the outside traffic to Shimla road. This stretch has a total length of 2.5 Km. Fig 3.1 shows the stretch selected as study area.

Fig. 3.1: Study Area Google Earth View

3. MODELINGTHENETWORK

The study area with four signalized intersections is modelled in VISSIM.

The road links, connectors, intersections are built in the network. Then the route decisions are provided. The vehicle inputs and composition are defined. Then the relative flows and reduced speed areas are defined in the network. Now the model needs to be calibrated and validated successfully so as to produce reliable results.

4. CALIBRATION OF VISSIM NETWORK MODEL

The simulation models with the default parameters can give misleading output results. Thus the model needs to be properly calibrated, so that it represents the field condition to its best. Calibration can be performed by varying the driving behavior parameters. The model contains driving behavior parameters which are set to default values. These values can be changed according the actual field conditions.

Initially the volume and speed data collected was fed into simulation model. The driver behavior and vehicle behavior parameters were taken as default for the first trial run of the software. The vehicle volume simulation output was noted for three mid-sections i.e. between staggered intersection 1-2 and T-intersection 3, between T-intersection 3 and staggered intersection 4-5 and between staggered

Intersection 4-5 and four legged intersection 6. The network model shows high error when it is used with default parameters.

The default lane change distance in VISSIM is 200 m. That means that 200 m before the intersection the driver decides its lane according to its turning movement. But in real condition the drive follows the lane according to its turning decision, much before the intersection. Thus for the lane change distance calibration, the distance of 20 m best represented the field conditions, thus the lane change distance value is taken as 20 m.

The lateral minimum distance of the vehicles at 0 km/h and 50 km/h are set to a default value of 1m in the model. Since in India drivers do not follow lane wise movement, thus the calibrated value of lateral minimum distance taken are shown in Table 1.

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Table 1: Calibrated Lateral Minimum Distance between Vehicle in the Network

Veh. Class	Default Lateral Min. Distance in m. at 0 km/h		Default Lateral Min. Distance in meter at 50 km/h	
	Default	Calibrated	Default	Calibrated
2W	1	0.3	1	0.6
3W	1	0.3	1	0.8
4W	1	0.3	1	0.8
Bus	1	0.3	1	0.8

In Indian driving conditions, drivers do not follow single lane. Overtaking and cooperative lane changes was observed in the field. Under default parameters in VISSIM, the overtaking is not allowed and no cooperative lane changes are allowed. Thus according to the field scenarios the overtaking and cooperative lane changes are allowed.

The fourth parameter which is identified and used for calibration is minimum headway distance. The default value of minimum headway is 0.5m and different simulation for the different values of minimum headway shows that the default value gives the minimum error while comparing the simulated vehicle flow with the actual vehicle flow. So, minimum headway is kept as it is i.e. 0.5m.

5. VALIDATION OF VISSIM NETWORK MODEL

The validation has been performed for the other parameter called average speed of vehicles at the three mid sections. The mid sections are the same mid sections on which calibration process was done earlier.

The results show that the average percentage error between the actual field average vehicle speeds and the average vehicle speeds in the simulation model is 0.089. This is a satisfactory result. Thus thesimulation output satisfactorily matches the field conditions for the average vehicle speed at mid-sections. Therefore, the model is successfully validated.

6. SIGNAL OPTIMIZATION

After setting up the network in VISTRO, a default signalization is created. Then the network is optimized with the help of optimization split tool in the work panel. Then the signal timings for the selected intersection gets populated. Any adjustments if needed can be made manually. Thus the intersection signalization gets ready with the full analysis created by the VISTRO. The signal program optimized in VISTRO for the six intersections i.e. intersection 1, 2,3,4,5 and

6 are given in Fig. 2 to 7.

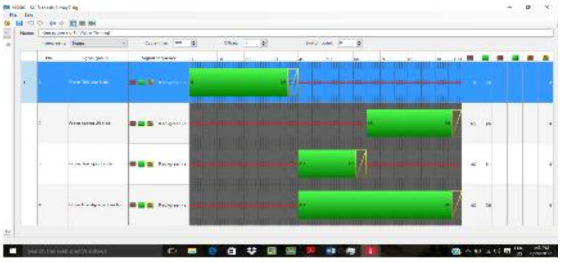

Fig. 2: VISTRO optimized Traffic Signal Program- intersection 1

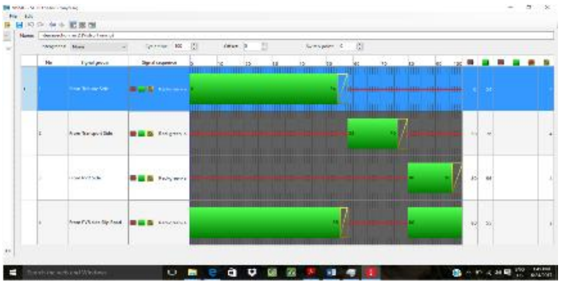

Fig. 3: VISTRO optimized Traffic Signal Program- intersection 2

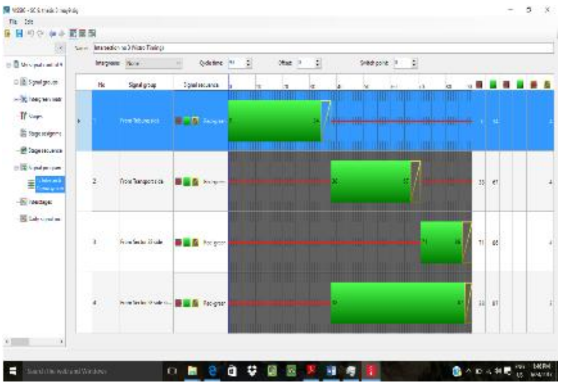

Fig. 4: VISTRO optimized Traffic Signal

Program- intersection 3

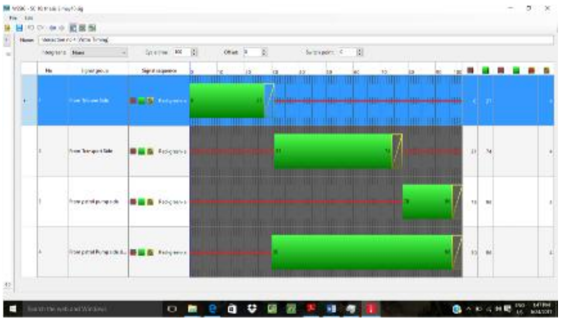

Fig. 5: VISTRO optimized Traffic Signal Program- intersection 4

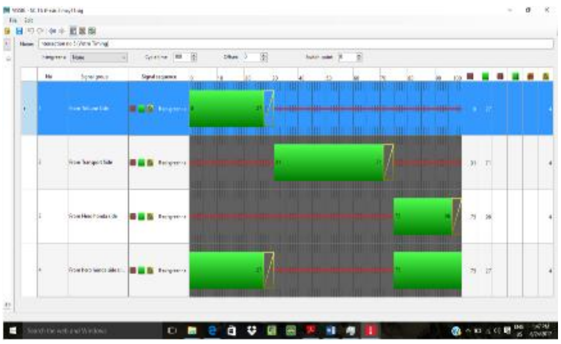

Fig. 6: VISTRO optimized Traffic Signal Program- intersection 5

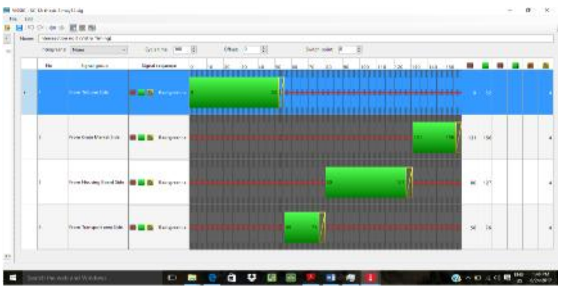

Fig. 7: VISTRO optimized Traffic Signal Program- intersection 7

7. COMPARISION OF RESULTS

After generating the optimized signal timings the next step is to use those signal timings in the VISSIM network model in order to check that, whether that signal timing is helping to reduce the total travel time of the commuters or not. For this analysis the queue length parameter is taken. Queue length lines are placed at every intersections in order to calculate the queue lengths of vehicles. After using the VISTRO timing the queue lengths has been decreased. The comparison of queue lengths of Field signal timings and the VISTRO signal timing is shown in Fig. 8 to 13.

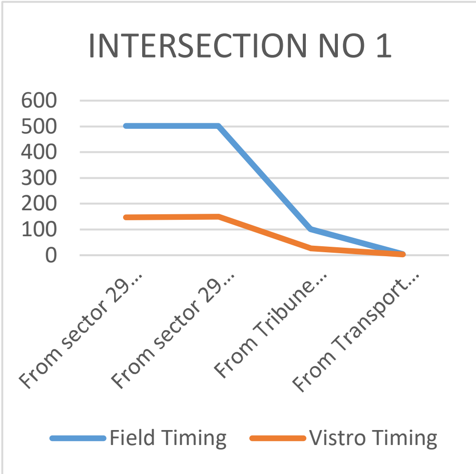

Fig. 8: Queue Lengths-Intersection-1

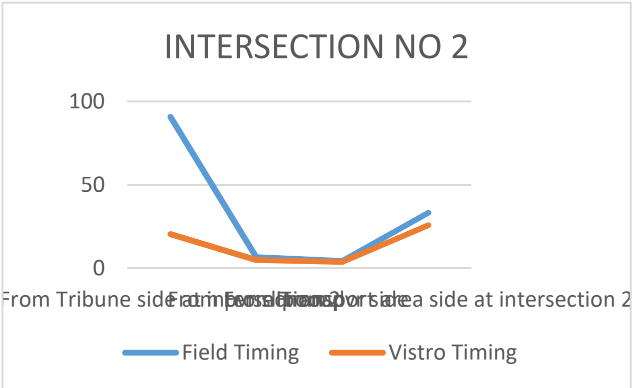

Fig. 9: Queue Lengths- Intersection -2

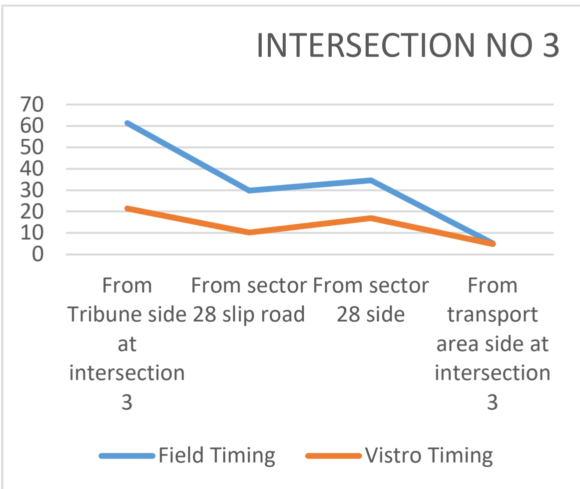

Fig. 10: Queue Lengths- Intersection-3

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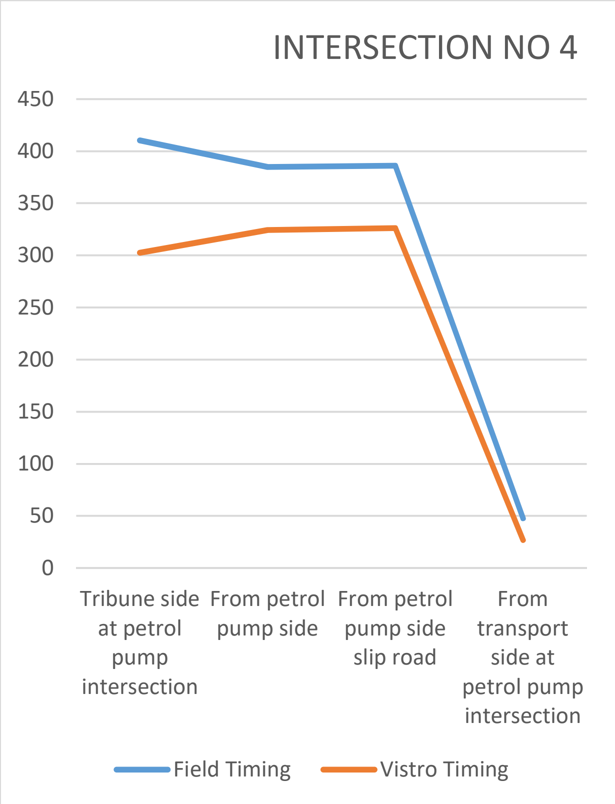

Fig. 11: Queue Lengths-Intersection-4

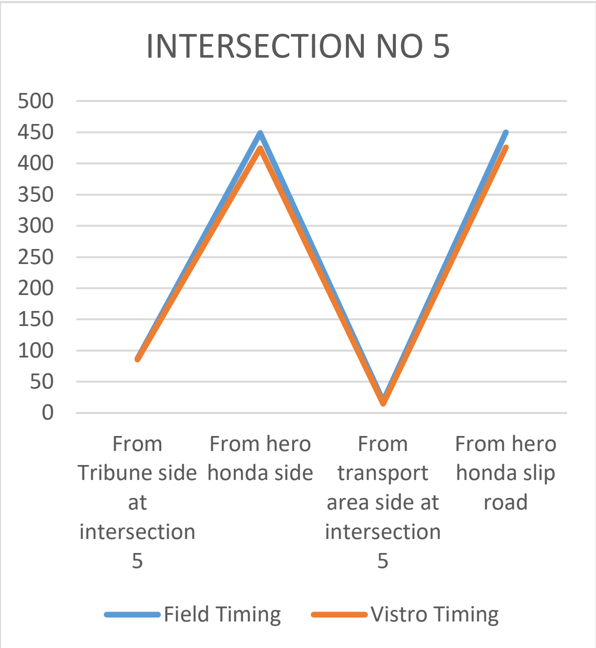

Fig. 12: Queue Lengths- Intersection -5

Fig. 13: Queue Lengths- Intersection -6

8. CONCLUSIONS

From the whole study and results generated the following conclusions have been drawn:

• Simulating the VISSIM network model with default values gives higher mean percentage error of 44.06%.

• After calibrating the VISSIM network model with the modification of lane changing distance from the default value of 200m to 20m reduces the mean Percentage error from 44.06% to 37.83%.

• After allowing the overtaking and co-operative lane change the mean percentage error is reduced from 37.83% to 18.07%.

• After the modification of minimum lateral distance between the vehicles of all classes from the default values the mean percentage error is reduced from 18.07% to 10.89%.

• The default value of minimum headway is 0.5m and there is no need for its modification because if its value is increased or decreased the mean Percentage error is increasing from 10.89%.

• Validation process is done by taking another attribute which is average speed of all classes of vehicles. The average speed at the mid-block sections of every intersection is computed and it shows quite satisfactory results with a mean percentage error of 8.98%.

• After generating the optimized signal timing for the network model using VISTRO and comparing the queue lengths at all the approaches it was found that the field timing is not good according to the traffic volume.

• With decrease in the queue length generated from the optimized signal timing it proves that there will be a reduction in the delays at all the Intersections. Using optimized signal timing the travel time of the commuters will be reduced.

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