Re-design of typical existing T-intersection of selected Roads junction using VISSIM microsimulation software

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Abstract - Currently, increase in growth of urbanization and traffic is causing the congestion and formation of long queue in roads and at intersections. Critical studies including Video graphic survey is carried out and a detailed Turning Movement Count (TMC) conducted at the selected T-intersection of Indirapuram, New Delhi, which is having a very high traffic volume. VISSIM software with Microsimulation model used to Re-design selected T-intersection of Indirapuram, New Delhi. The VISSIM model with modified driving behaviour parameters helps to create a virtual environment representing the traffic scenario, optimize the problems and visualize the outputs. Capacity of existing intersection is calculated according Indian Highway Capacity Manual (Indo-HCM). Alternative proposals are modelled by using VISSIM microscopic simulation software. Queue lengths are measured in the existing and proposed model. The results generated from the VISSIM microsimulation software developed a scenario which results in delay being reduced by 41% with signalized condition. There is also reduction in the queue length and is being reduced by 22% when compared to existing condition.

Key Words: *T-Intersection, Conflicting Point, VISSIM microscopic simulation software, Highway Capacity, GEH Error, Level of Service.*

1.INTRODUCTION

Transportation contributes to the economic, industrial, social and cultural development of any country. The number of vehicular populations are increasing day by day and the rotary and traffic signals designed two or three decade ago are now not sufficient, operational & also functional due to typical inflow of users. Critical study and redesign of these intersections become very much necessary to provide a seamless traffic flow for present population as well as for projected population growth to overcome problem like congestion, accidents and pollution. The Indian capital Delhi have heterogeneous traffic system that enhances severe congestion and pollution especially in roads intersection because of radical increase in number of vehicles. According to a report on Roads Accident in Delhi - 2017 published by the DELHI TRAFFIC POLICE, more than 1600 people died in 2017 as a result of roads traffic crashes. Delhi over the years has perceived enormous growth of population due to continuous movement of people from neighbouring states due to centralized capital, in search of employment and business. The phenomenal growth of roads transport has carried along with it the serious problem of traffic accidents. There has been an accumulative trend in the number of roads accidents as well as casualties from year to year. The main causes of such high rate of accident is mainly attributed to the inadequacy of the roads to meet the traffic demands, roads user behaviour, vehicle defects, poor roads geometrics and visibility, poor designing of intersections, lack of pedestrian facilities, poorly maintained footpath, encroachment of roads by hawkers, improper visibility of roads obstruction due to lack of street lighting, lack of signage's useful for pedestrian safety, ignorance of roads safety rules, lack of efficient control measures, unregulated urban expansion etc.. Roads accidents cause heavy economic loss to the country. Roads Safety is enforced to reduce accident involving both human and vehicles there by making the roads safer and user friendly to traffic.

Athul Suresh et al. (2016) demonstrates the efficiency of PTV VISSIM software to replicate the traffic conditions of a rotary intersection in the city of Silchar, Assam. VISSIM is microscopic traffic simulation software, which helps to create a realistic situation of the heterogeneous field conditions. Arpan Mehra et al. **(**2012**)** conducted study on Highway Capacity through VISSIM Calibrated for mixed Traffic Conditions and inferred that the simulated data were compared with the field data. Dipika Gupta et al. (2014) they studied about the congested urban area is selected for the study which is facing traffic congestion. Dong Lin et al. (2013) they studied about the VISSIM based Simulation Analysis on Roads Network of CBD in Beijing, China analysed that in order to find the appropriate inference, behavioural studies were performed before model build up for four different traffic organisations. Arpan Mehra et al. (2012**)** conducted study on Highway Capacity through VISSIM Calibrated for mixed Traffic Conditions and inferred that the simulated data were compared with the field data.

The purpose of this research is to overcome or minimize this human errors or manual errors in conventional design of intersection the emerging computer software-based technologies are being used. The existing condition of identified T-intersection is modelled with proper checks by using VISSIM Microsimulation Software.

2. Methodology

In this research location of Indirapuram, New Delhi is selected for the purpose of model development. The reason for selection of this location is because of unbalanced flows it is very prone to roads accidents and has very long queue formation which results in long delays, especially during the peak hours.

The classified volume count survey is conducted for morning peak hour (07:00 AM to 12:00 PM) and evening peak hour (04:00 PM to 08:00 PM). Turning movement count survey is conducted for all six direction of T-intersection using video graphic method.

Table -1: Traffic Volume of selected Roads junction

Site Identity	Gyan Khand Road		Shushila Naiyar Road		Kala Pathar Road	
Time	A_1	A_2	B_1	B_2	C_1	C_2
08:00-09:00	282	1770	572	273	131	912
09:00-10:00	307	2555	618	363	170	1231
10:00-11:00	298	1996	558	412	220	1386
11:00-12:00	392	1502	544	419	262	1387
16:00-17:00	415	1022	492	317	261	1274
17:00-18:00	391	1100	497	324	264	1494
18:00-19:00	455	1230	629	363	307	1669
19:00-20:00	521	1234	639	384	334	1894

VISSIM Simulation

The simulations are run for a period of 3600 seconds, of which the first 600 seconds are considered as a warm up period for the network to reach a steady state, and the last 300 seconds are considered as a cooling period, the data for these 2 tail ends are either not generated or are disregarded for evaluations. Every simulation consists of three multi-runs and the average of these runs are taken as one output. The random seeds are varied within these three multi runs, using the random seed increment function within the simulator, this can be any arbitrary value, for this study, the value was set as three.

Calibration and Validation

Micro simulation is a tool for analysing the performance of roadways that have complicated geometric configurations and congested traffic. Calibration is necessary for these models because no single model can be expected to be equally accurate for all possible traffic conditions. In general, microscopic simulation models contain default values for each variable, but they also suggest that users to input a range of values for the parameters that better suit their unique condition. The difficulty in basing calibration on field observations is that many of the parameters used in simulation models are difficult or sometimes impossible to measure in the field, yet they can substantially impact on the model's performance.

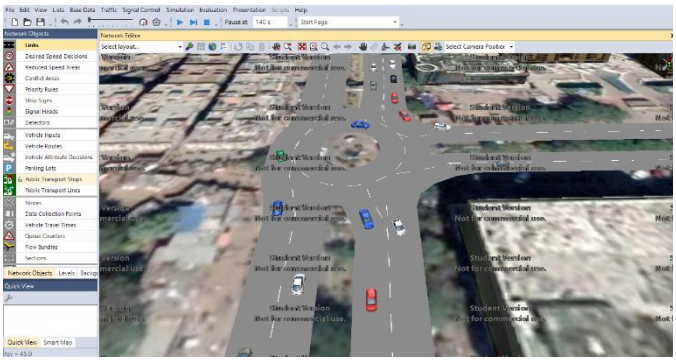

Fig -1: Existing Rotary on the selected roads junction

Fig -2: Proposed alternative for selected roads junction

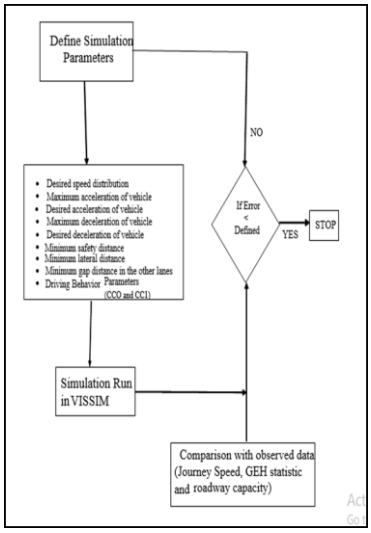

Fig -3: Methodology employed for Calibration of Micro Simulation Model

default values which are built up in software is for homogeneous traffic condition but our Indian condition has mixed traffic condition. Hence the default value has been changed according to our condition.

Table 2- Statistics calculated for each approach of T-intersection of Indirapuram

Time Interval	Lane Direction	Veh (act)	Veh (sim)	GEH ERROR
0-3600	A_1	282	295	0.7867
3600-7200	A_2	320	303	0.9632
0-3600	B_1	363	375	0.6247
3600-7200	B_2	572	512	2.5772
0-3600	C_1	220	199	1.4508
3600-7200	C_2	278	264	0.8504

In the above table A_1, A_2, B_1, B_2, C_1, C_2 represents the arm of T-intersection such as Gyan Khand road, Shushila Naiyar road and Kala Pathar Road respectively.

The GEH value calculated for each approach of the Indirapuram T-intersection satisfied the condition of less than 5 and which implies good match between the modelled and observed hourly volumes. GEH value is calculated as: -

$$GEH = \sqrt{\frac{2(M-C)^2}{M+C}}$$

Where,

M = hourly traffic volume from the traffic model (or new count)

C = real-world hourly traffic count (or the old count)

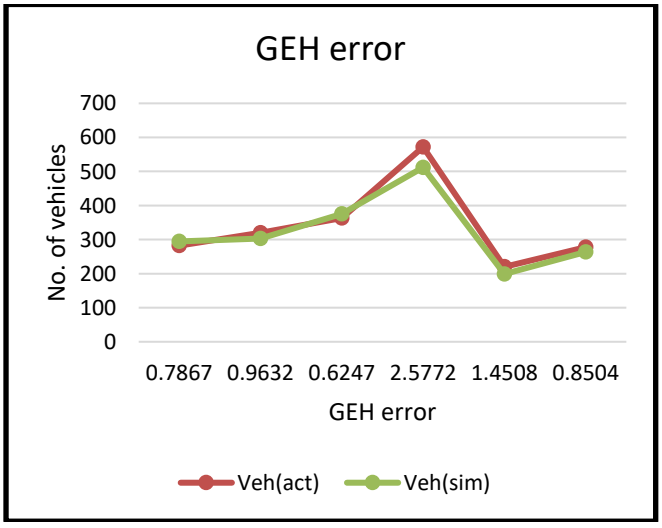

Fig 4- Graphical representation of GEH error

Table 3- Existing Condition of T-intersection of Indirapuram (As per VISSIM)

TIME INTERVAL (Seconds)	DIRECTION		QLEN (Meters)	VEH DELAY (Seconds)	Level of Service
0-3600	Gyan Khand Road	A_1	53.61	65.92	LOS-E
0-3600		A_2	53.61	69.42	LOS-E
0-3600	Shushila Naiyar road	B_1	19.05	29.26	LOS-C
0-3600		B_2	19.05	49.04	LOS-D
0-3600	Kala Pathar Road	C_1	69.7	105.3	LOS-F
0-3600		C_2	69.7	86.44	LOS-F

Table 4- Proposed design for T-intersection of Indirapuram (As per VISSIM)

TIME INTERVAL (Seconds)	DIRECTION		QLEN (Meters)	VEH DELAY (Seconds)	Level of Service
0-3600	Gyan Khand Road	A_1	47.21	44.57	LOS-B
0-3600		A_2	47.21	24.05	LOS-C
0-3600	Shushila Naiyar road	B_1	28.62	9.7	LOS-A
0-3600		B_2	28.62	9.98	LOS-A
0-3600	Kala Pathar Road	C_1	57.24	42.49	LOS-C
0-3600		C_2	57.24	25.77	LOS-D

3. CONCLUSIONS

The critical study of T-intersection revealed that the identified location of T-intersection at Indirapuram, New Delhi has no signalling, no street lighting, and no engineering design of intersection. It is also observed that T-intersection has been encroached by hawkers, venders and improper parking. The improper parking and above-mentioned observations become the causes of obstruction to roads user which ultimately affected the smooth flow of traffic movement. The existing rotary is creating congestion and delay in traffic movement hence, it is required to remove rotary and provide channelized intersection with signal in proposed re-design. The results generated from the VISSIM microsimulation software developed a scenario which results in delay being reduced by 41% with Proposed condition. There is also reduction in the queue length and is being reduced by 22% when compared to existing condition.

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