Scientific Journal of Impact Factor (SJIF): 5.71

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 6, Issue 05, May -2019

Evaluation of Two Wheelers on Heterogeneous Traffic Using VISSIM Software: A Case Study of Ambedkar Intersection

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Abstract- *In present scenario due to Urbanization and Industrialization, there is rapid growth of vehicle which leads to traffic congestion and accidents. Generally, heterogeneous traffic exist in developing countries where the percentage of two wheelers are more as compare to other classes of vehicles which creates problem of delay and queue length for the metropolitan cities because of its high maneuverability. In addition to that the growth of traffic with no proper lane discipline and varying static characteristic even in the same class of vehicles causes effect of operational efficiency of intersection. The problem related to T-legged intersections is not fully analyzed in a road network in developing countries for two wheelers at all. VISSIM is traffic microscopic simulation software which has the huge scope of application to solve various traffic engineering related problems. This article presents right and left traffic movement analysis with the help of VISSIM software for the T-legged intersection with three phases design and analysis of the two wheelers delay effect on other vehicles movement of the T-legged intersection.*

Key words *- Intersection, Redesign, Queue length, Delay, VISSIM Simulations*

I. INTRODUCTION

Intersection is a junction where two or more roads cross or meet each other at same grade level. The intersection area has all modes of traveling including vehicles, bicycle, pedestrians and transit. Intersection also encompasses auxiliary lanes, island, medians, sidewalks and pedestrian ramps. The prime objective of any type of intersection is to facilitate the roadway user and enhance the efficient vehicle movements , the intersection is designed based on the scope, shape, flaring and channelization with consideration of design factors such as human ,traffic , physical and economic factors .Intersection has various types these including T-legged, four leg ,multi leg and roundabout intersections while determining the type of intersection some variables (traffic characteristics,topography,number of legs, type of operation) are required to be considered. The typical three legs intersection also known as T-legged intersection consist of left and right lanes with angle range from 60-120 degrees. The complexity of intersection increases as the number of approach increases, meanwhile the potential conflicts for all users also increases such as merging, diverging, crossing conflicts. To control the movements of intersection, there are various methods one of them is to install traffic signal at the intersection, for doing this phasing and timing must be developed .Once the phasing, cycle length, green times, yellow times are determined, later on the intersection performance can be evaluated. The most common measures in signalized intersection are delay per vehicle, queue length. Delay is a measure that most directly relates driver's experience and it is measure of excess time consumed in traversing the intersection. Length of queue at any time is a measure parameter for determining the capacity and traffic control quality of traffic, and is critical in determining when a given intersection will begin to impede the discharge from an adjacent upstream intersection. In order to analyze these two measures of traffic engineering, we do a traffic simulation work by using VISSIM software. VISSIM is a microscopic, time step and behavior-based simulation model developed to model urban traffic and public transport operations and flows of pedestrians. The program can analyze private and public transport operations under constraints such as lane configuration, vehicle composition, traffic signals, PT stops, etc., thus making it a useful tool for the evaluation of various alternatives based on transportation engineering and planning measures of effectiveness. The study deals with a T legged intersection of Ambedkar circle located in Alkapuri area of Vadodara district. The intersection is signalized with left and right traffic movements only with one leg straight movement traffic .To redesign the intersection and analyses of the delay and queue length several traffic simulation software are available.VISSIM; as it is the practical effective simulative tool to evaluate for the effect of two wheelers effect on normal traffic in term of delay and queue length.

II. METHODOLOGY

2.1 Site Selection

Site selection includes Amberdkar T- legged intersection located in Alkapuri area of Vadodara district, it is congested area that the major road traffic is RC Dutt road OP road and Elora park road directions are minor roads.

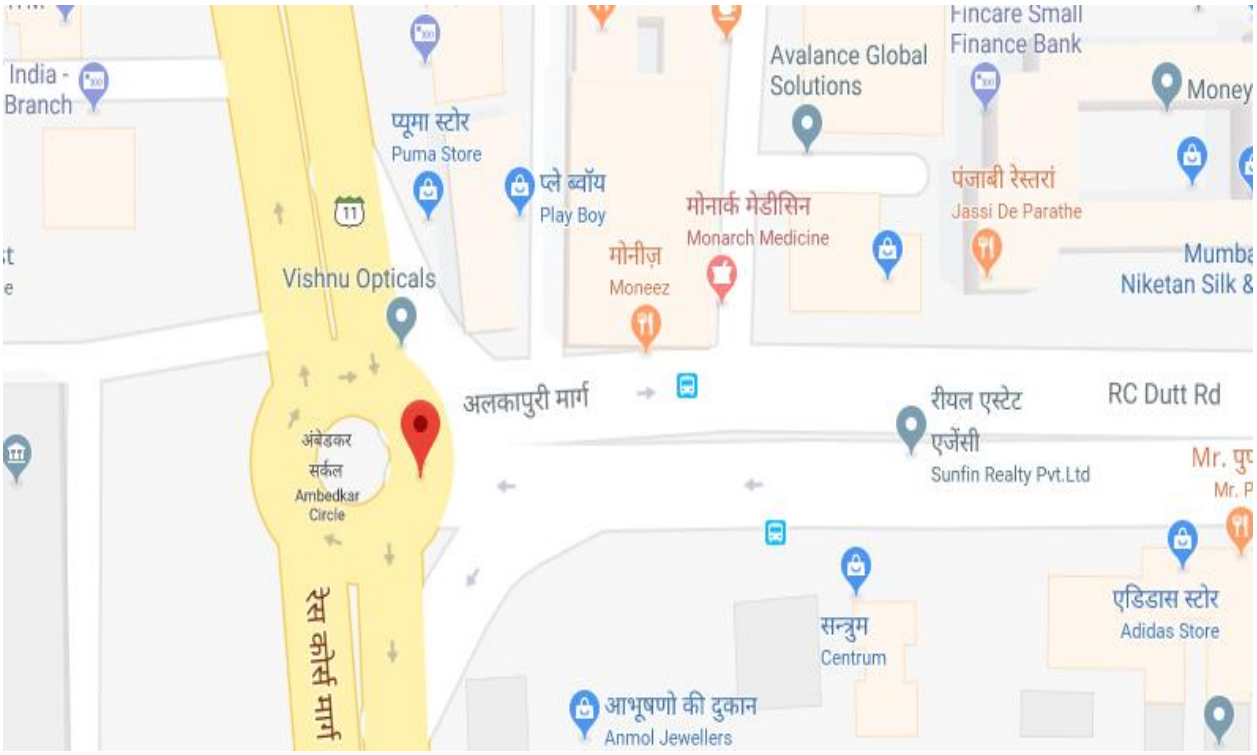

Fig.1 Location of Intersection

2.2 Data Collection

2.2.1 Volume count

Volume count survey was performed for peak hour count for three days of each approach manually. The data was collected in the format which was given in IRC-SP-19-2001.

Table:1 Volume count

Approach	Fast Moving Vehicle				Slow Moving Vehicle			Total
	Car,Jeep, Three Wheelers	Bus	Truck	Scooter/Motor Cycle	Cycles	Bullock Cart	Horse Cart	
Dutt Road to Ambedkar circle	771	91	82	1808	0	0	0	2752
Elora park to OP Road	885	80	66	1760	131	0	0	2922
OP Road to Elora Park Road	782	49	51	2010	182	0	0	2178

2.2.2 Speed survey

The parameter speed includes two speeds: Desired speed and reduced speed while turning from intersection. This paper uses radar speedometer on site speed data .Firstly ,the 200 sample of running speed collected .By analyzing it is found that speed follows normal distribution curve as shown in Fig.2 and the average speed is 30.7kph .

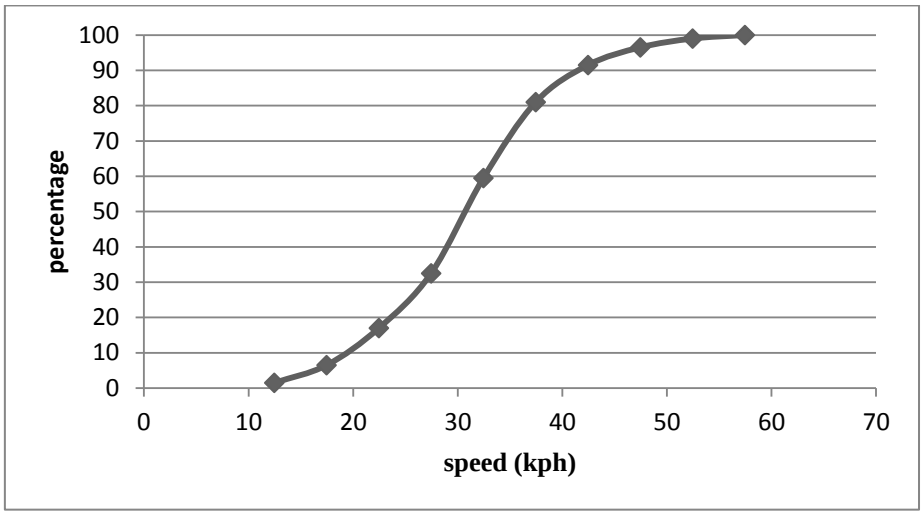

Fig.2 cumulative frequency curve speed of intersection

Moreover, the 85 percentile speed is 39.45 as shown in Fig.2 .

2.3 Manual redesign of signal

The three phase signal is designed based on the formulation of Webster's.

Table.3: Calculation of Y value in tabular form

No	Approach	Elora park road	OP road	Dutt Road
1	Flow (q) in PCU	687	578	771
2	Saturation flow in PCU	4725	4725	3675
3	Y ration (q/s)	0.15	0.122	0.21
4	Y_{max}	0.15+0.122+0.21=0.48		

Suitable Data Assumption :
Amber time = 3 sec
Amber/Red= 2 sec
I(Intergreen) = 3+2+2 =7 sec
Lose time :
$l = \sum(I - a) + \sum l = 3(7-3) + 3\times2 = 18$sec
Optimum Cycle Time :
Co = $\mathbf{C0} = (\mathbf{1.5}\boldsymbol{L}+\mathbf{5})/(\mathbf{1}-\boldsymbol{y}) = (\mathbf{1.5}\times18+\mathbf{5})/(\mathbf{1}-0.48) = 62$ sec cycle time
Effective green time for each approach:
Elora park road (G) = y_{elora}/y_{max} (co-L) = 0.15/0.48 (62-18) = 14 sec
OP road (G) = y_{OP}/y_{max} (co-L) = 0.122/0.48 (62-18) = 11 sec
RC Dutt road (G) = y_{Dutt}/y_{max} (co-L) = 0.21/0.48 (62-18) = 19 sec

Signal Timing diagram:

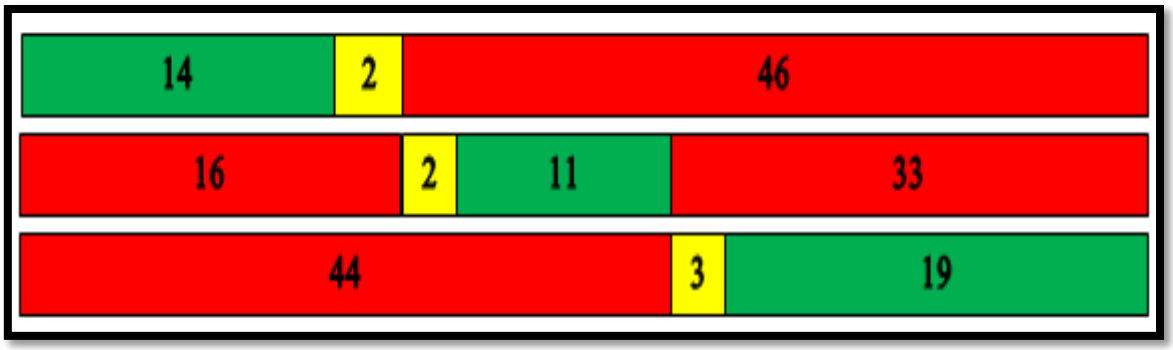

Fig.3:Signal Timing diagram

2.4 Model Build up in VISSIM (Steps)

First step to start the buildup of model is to set the background of software and selection of map which are existed by default ,to create geometry of roadway as per data of site , it is required to select object links and connectors to establish the geometrical features of our required elements .
After the creation of links and connector we apply the volume in option of vehicle input data as per survey of volume in unite of volume per hour. By giving the vehicle input and determining reduced speed area, we can run the simulation to see our vehicles movements as shown in Fig.4.

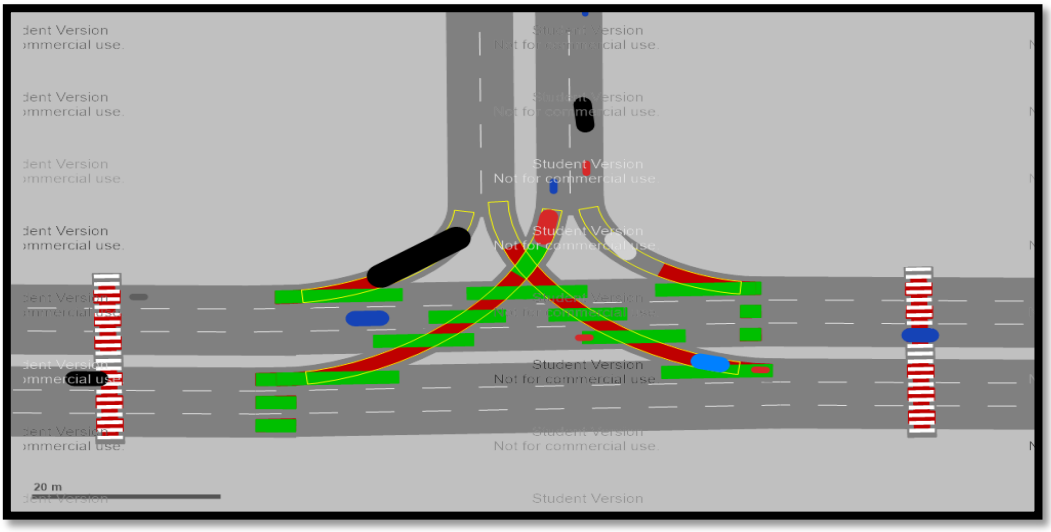

Fig.4 : Road Geometry,Volum and Conflict Area of Intersection

If the simulation was correct than proceed further and if it was not than check the input data. Further we had to give the vehicle route for each lane in each direction according to the volume of vehicles in that route as shown in Fig.5.

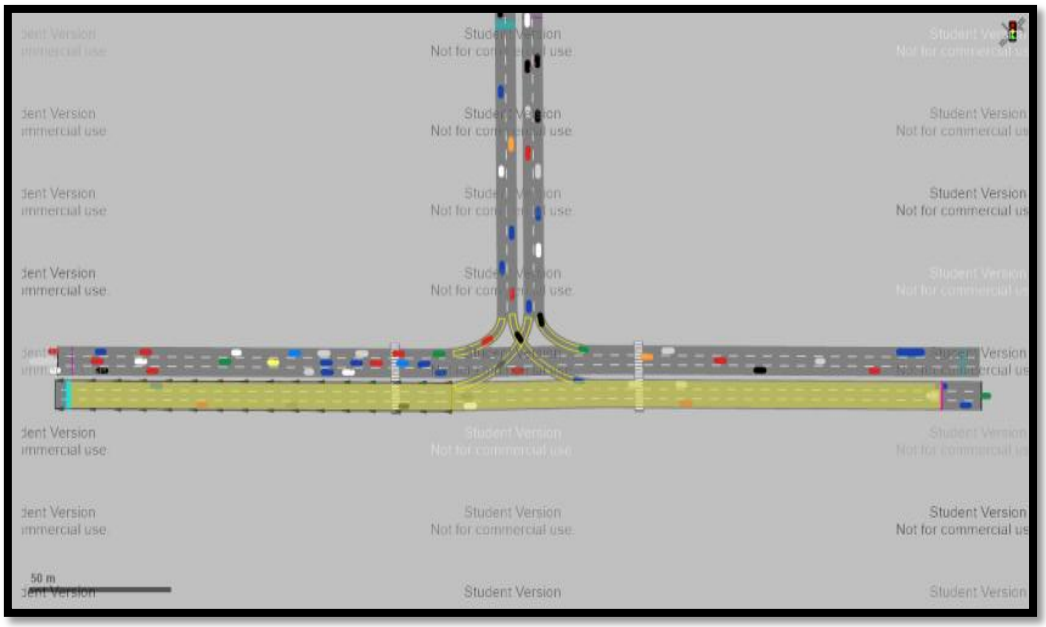

Fig.5: Route decision in VISSIM

Analysis of the conflict areas should be done at the point where traffic congestion is occurring. Run the VISSIM and see whether the simulation was according to the data given. The next step is fixing signal timing as counted manually for this,We need to make signal groups at intersection. After creating signal grouping we create one signal program for various groups .And check whether the signal timing is suitable for the congestion as in the Fig.6

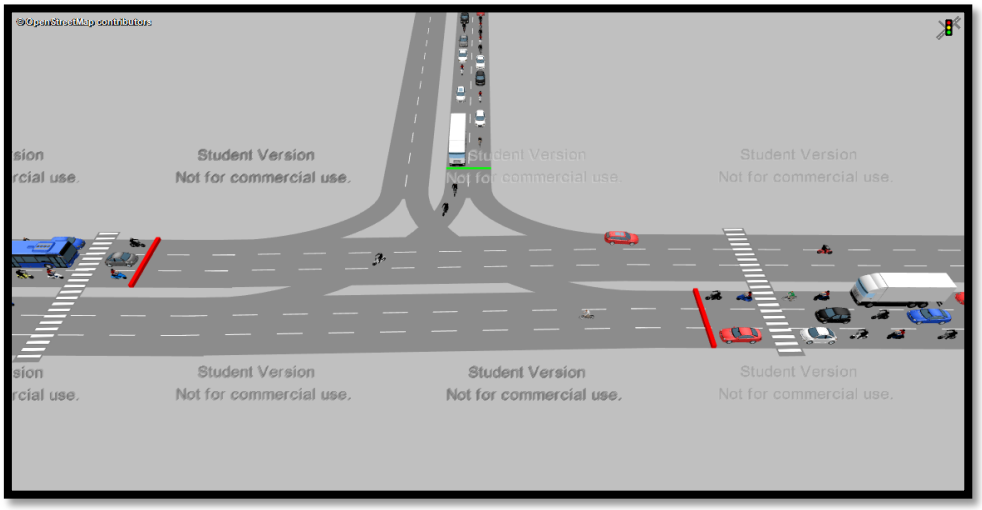

Fig.6: Signal Simulation for Dutt Road

III. RESULT AND DISCUSSION

3.1 Discussion on signal, Delay and Queue length

The main aim of this study is to redesign and simulation analysis of T-legged intersection of Ambedkar circle. As India is heterogeneous traffic with higher percentage of two wheelers in compared to other vehicles ,so the focus of the study is to find out the effect of two wheelers on the normal traffic in the selected intersection .For doing this analysis we firstly design signal timing the signal is designed in three phase for optimization purposes and avoiding conflicts ,than we can find the effect of delay and queue length of two wheelers .The delay of a vehicle in leaving a travel time measurement is obtained by subtracting the theoretical (ideal) travel time from the actual travel time .The theoretical travel time is the travel time which could be achieved if there were no other vehicles and/or no signal controls or other reasons for stops. Average queue length is in each time step, the current queue length is measured and arithmetic mean is than calculated per time interval.

3.2 Signal Timing Simulation Result

After entering the signal time ,the result of simulation found that the cycle time is adjusted to traffic flow with no congestion ,the main task is to adjust the signal timing and lower the delay .As currently the cycle time is 80 sec after redesign , it reduced to 62sec that 18 sec delay controlled as shown in below figure.

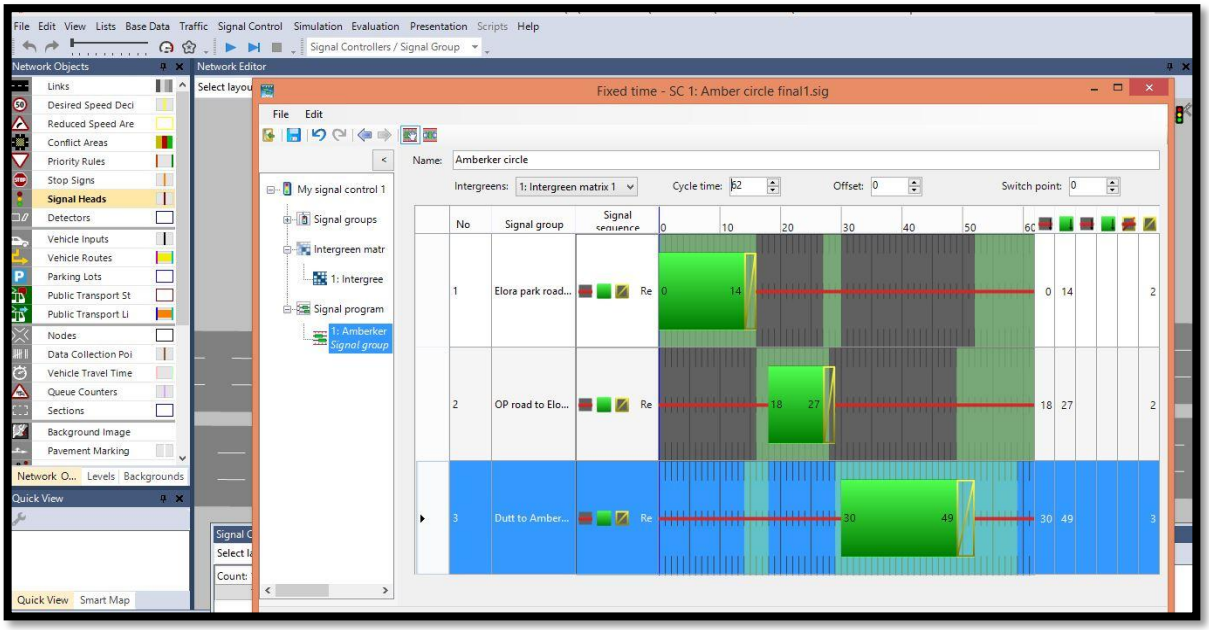

Fig.7: Timing for each approach

Table 4: Signal Timing Plan for Intersection

Phase	Traffic Direction Flow	Green Time (S)	Yellow Time (S)	Red Time(S)	Cycle
1	Dutt Road Flow	19	2	41	
2	Elora Park Road	14	2	46	62
3	Op Road	11	2	49	

3.3 Queue Length Simulation Result

Traffic queue length is the distance that vehicles queuing in front of the detection line. The queue length is evaluating from selection of Node at 100m in time interval of 0-100 sec, this task is proceeded for 5 trails with 10 percent reducing of two wheelers volume of each approach and compare with the normal traffic.

Table.5: Simulation result of VISSIM for Queue length at Time Interval 0-100

Approach	Total Traffic of Direction		10% Reduced of Two Wheeler		20% Reduced of Two Wheeler		30% Reduced of Two Wheeler		40% Reduced of Two Wheeler		50% Reduced of Two Wheeler	
	Flow	Q	Flow	Q	Flow	Q	Flow	Q	Flow	Q	Flow	Q
Dutt Road	1808	66.4	1627	63.96	1446	60.07	1265	53.61	1085	52.16	904	55.42
Elora Park Road	1760	84.7	1584	82.16	1408	71.43	1232	79.17	1056	59.84	880	65.98
Op Road	2010	54.4	1809	33.7	1608	27.91	1407	21.16	1206	27.35	1005	17.03

Note: The flow in the table is two wheeler volume per hour in each direction.

3.4 Simulation Result of Delay

Delay is a measure that most directly relates driver's experience and it is measure of excess time consumed in traversing the intersection. delay is the most frequently used measure of effectiveness for signalized intersections for it is directly perceived by a driver. The estimation of delay is complex due to random arrival of vehicles, lost time due to stopping of vehicles, over saturated flow conditions etc. The VISSIM result was taken from nodes of intersection and the given figures are the average delay of vehicles for the same volume of as for queue length was proceeded as shown in the table below.

Table.5: Simulation result of VISSIM for Queue length at Time Interval 0-100

Approach	Total Traffic of Direction		10% Reduced of Two Wheeler		20% Reduced of Two Wheeler		30% Reduced of Two Wheeler		40% Reduced of Two Wheeler		50% Reduced of Two Wheeler	
	Flow	Delay	Flow	Delay	Flow	Delay	Flow	Delay	Flow	Delay	Flow	Delay
Dutt Road	1808	27.88	1627	26.51	1446	22.96	1265	20.2	1085	18.15	904	16.08
Elora Park Road	1760	21.22	1584	20.6	1408	20.55	1232	19.68	1056	17.17	880	15.18
Op Road	2010	32.48	1809	27.74	1608	25.05	1407	24.05	1206	23.92	1005	23.08

IV. CONCLUSION

Transportation related problems are needed to be solved by its reasonable solution. VISSIM is useful tool to analyze both macro-scopic and micro-scopic modules problems. VISSIM Module are accurate and are practically verified also can be used to simulate the traffic including vehicles, pedestrians, BRTs etc. This paper focuses on the T-legged intersection with three phase manual and software design, and the effect of two wheeler volume on the normal traffic in term of delay and queue length by using the VISSIM software .As the task was fulfilled on the nodes of intersection. According to the input data to VISSIM and the result of its simulation as above tabulated shows that the reducing of two wheeler volume significantly effect and may decrease the queue length and delay for the other classes in heterogeneous traffic.

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