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Saturation and Delay Model Microsimulation Using Vissim - A Case Study

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Abstract- **Traffic in India consists of mainly to parts both motorized and non-motorized traffic with no lane movement of vehicles and no restricted mixing up of flow this has led to heterogeneous traffic condition in India determination of PCU values in mixed traffic condition was a challenge. Saturation flow and delay model of particular intersection will help in determine the various loop holes in the present given condition and help in certain corrective measures for the same. Here in this paper I have developed a saturation and delay model for the selected junctions in Bangalore city and microscopic simulation model is being prepared for the same by using VISSIM software validation of same is carried out and certain proposals have been suggested for same in order to improve the condition of present area.**

I. INTRODUCTION

Bangalore is an important metropolitan city in India with and considerably increases in population year to year. Due to increase in population there has been a considerable rise in the number of vehicular movement. The traffic proportion consist, major portion of two wheelers, four-wheelers and auto. Growing traffic in metropolitan city will lead to considerable effect on to particular city or location whether it can be overall economical aspect or land use pattern effect .

It can been seen in Bangalore city that as the traffic keeps on increasing considerably it leads to effect on to the present traffic , as the present transportation network is not able to meet the needs of growing traffic this has led to major traffic problems . Since certain traffic network are designed keeping in mind the projection of future traffic still it is not able to meet the needs of the present excess amount of traffic .

Hence saturation flow is like a building block for determination of the capacity and delay of the selected area.

Delay study is needed in order to determine the extra time spent by the vehicle and overall extra increase in travel time. I have selected the intersection where the amount of traffic is very high and it has high amount of saturation flow and considerable amount of delay is high.

Saturation flow helps in overall analysis of the present intersection facilities and whether it meets the present needs and requirement. Various features to be taken into consideration while analyzing the junction is overall signal cycle length, (green cycle is the key factor), geometrical features, road width and various important features. If the traffic is homogenous then it would be easy to analysis the traffic but our country consists of heterogeneous traffic where it leads to certain problem to detriment the PCU value of different class of vehicle. There was considerable high amount of traffic during both the peak and off peak hours of selected area for study.

Different study area was selected by keeping in mind increase in traffic of selected area over areas and considerably saturation rate and delay of vehicular movement in that particular selected area. This microscopic simulation models are more flexible when compared to normal manually method of calculations we can check both the boundaries condition in the field by this model. The VISSIM microscopic simulation model is being widely used in traffic behavior studies which has given a considerably realistic output of the given data and obtained output can be easily relayed on and can be used for the further studies or reference.

Three junctions where selected since high saturation value and delay in that particular section were caused due to heavy traffic or capacity of the road. The present traffic lead to traffic conditions like congestion, delay etc. The three locations selected for obtaining data for this report where as follows:

1. Oklipuram junction (old Mysore road)
2. KR market
3. Tin factory junction (near to suspension bridge)

1. Oklipuram

This location is a three legged intersection, with a high rate of congestion and delay due to huge amount of traffic being more than the road capacity. The main cause of delay being no proper signal timing and one leg of the intersection had considerable high amount of traffic nearly 5000-6000 vehicles/hour. Thus it led to green phase given to this particular leg and this formed queue length of the other leg.

The selected area is 1.5 km from Majestic. Majestic is CBD area this more no of vehicles move toward and originate from this area. This area consists of one temple and one church certain peak hours this has led to more conjunction due to no of people visiting

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Figure 1: selected stretch of Mysore road for study

2. Kr Market

This particular location was chosen because it's in near to one of the important areas like avenue road and SP road where the condition of traffic of the commuters is considerably high. The main cause of conjunction and delay in this junction was due to more of pedestrian's ad a location of bus stand which has greatly hindered or effected the traffic movement. Due to presence of huge no of pedestrians there is a necessity of clearing the traffic with the help of traffic police. The amount of heavy vehicles and two wheelers where considerably high in this junction and the movement of vehicle was of snail speed

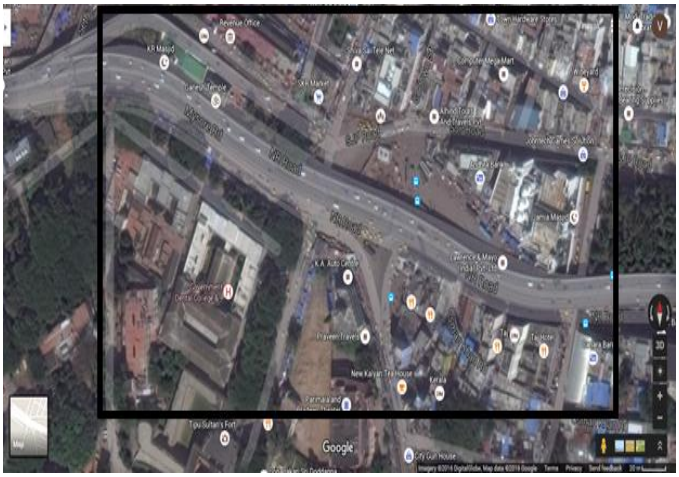

Figure 2: Google Earth Image Kr Market

3. Tin Factory

The selection of this particular junction is due to high number of goods vehicle and the conjunction is very high due to presence of huge no of pedestrians. The main cause of delay was the pedestrians because of presence of railway station near to this area and sometimes police intervention is required to control the traffic. Even though a flyover is constructed in this place it's not able to reduce the traffic which has led to huge amount of traffic problems in this particular area.

Figure 3: Google Earth Image Tin Factory

All these three locations where selected in such a manner, where the field data and the VISSIM simulated data could be validated for delay and saturation values by relevant inputs like geometrical details, volume count. All the three locations consists of three legged and the traffic signal timing was recorded for the same.

II. DATA COLLECTION

The technique involved in the collection of data are as follows:

Video recording method has been carried out. Certain building was selected for fixing of camera through which signal timing and volume count was recorded.

For few selected junctions the volume count was carried out by means of manually noting down the number of vehicles in each particular leg by enumerators.

Volume count survey was carried out by recording the different class of vehicles for 15 min intervals and for three hours in the morning and evening peak hours.

Spot speed was calculated by carrying out time mean and space mean study by marking the distance on the selected stretch of road.

Video cameras are placed in upper position for data retrieval of the whole junction

Turning movement and queue length is noted down

Signal type and time of whole signal cycle length is obtained for future analysis for calculating

Saturation value of vehicle is noted down during the saturation green phase.

A. DATA RETERIVAL

- In case of video graphic survey data is extracted by playing the video on desktop or laptop.
- Once the volume count is completed then the peak hour factor for the same obtained is data and PCU values are calculated.
- PCU values are calculated by means of Chandra's method where the projected area and speed of particular class of vehicle is correlated and values are obtained for different class of vehicles.
- Once the values are obtained it is converted into obtained volume into PCU values.
- Peak hour is decided by means of high volume of vehicles in certain particular hour both in the

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morning and evening hour. In case of the survey it was seen during 9 to 10 AM and 5.30 to 6.30 PM

- This peak hour volume is used to analyze and calculate the delay values. Saturation flow of all the three junction is calculated in the following ways as follows:

Saturation values in the selected area is calculated by number of enumerators at the selected location For each leg two enumerators are required to note down the data This data can be obtained by video graphic survey also but it will be a tedious work and video needs to be stopped for every green cycle

Here in this project survey was carried out manually to avoid the multiple work involved

QUEUE LENGTH

- Queue length of junction is noted down by marking certain distance on the pavement
- Once the signal turns red the length of the queue generated is noted down, for example distance say 250 m or 350 m of the selected stretch
- The length of the queue is noted down and used for comparison through the delay analysis of the same junction and while simulating in the VISSIM software.

B. DELAY STUDY

- This survey was carried out by noting down the number of vehicles in the queue length of that location
- Based on the peak hour traffic then a new excel sheet was generated and required values were obtained
- Using HCM manual, delay results of particular route is obtained and same was developed.

Figure 4:congestion in oklipuram junction

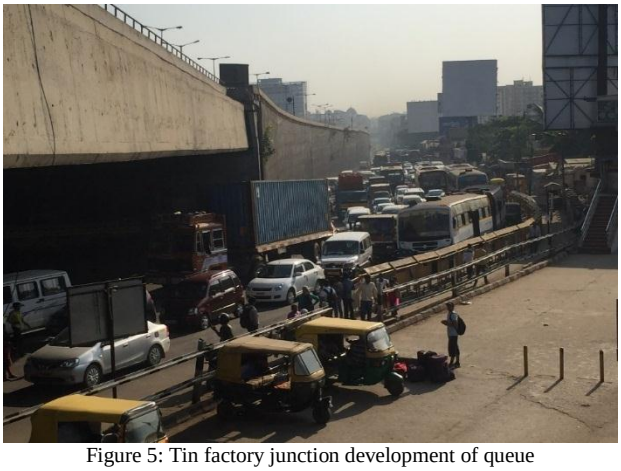

Figure 5: Tin factory junction development of queue

III. BASIC DETAILS OF SIGNALIZED INTERSECTION

A. General

A junction can either be signalized or un-signalized junction. Signalized intersection helps in free flow of traffic with the help of certain signal timing allotted to each leg of the stretch. This helps in the free and easy moment of traffic where the amount of work involved is considerably very less. In case of un-signalized intersection a traffic police is to be deployed to maintain the easy flow of traffic without much effect to the traffic. In case of such conditions certain difficulties arises where controlling of it will be a difficult task.

Important terms related with the signalized junction are as follows:

- Cycle length: it indicates the time of the whole duration including three phase of signal that is green ,red and amber
- Green time: It is a part of cycle length where during this stage the vehicles are allowed to move from the stopped position
- Green ratio: is the green time to that of the whole cycle length (g/c)

Traffic signals are of three different modes based on how they are being operated:

- Pre-timed operation: In this condition the cycle length of each signal is predetermined and fed into the system. This signal cycle will be same throughout the day
- Semi actuated operation: whereas here in this condition certain detectors are being used to control the cycle length which does not remain same through the day
- Fully actuated operation: more no of the detectors are used based on the amount of traffic the signal cycle length is being generated for the same

Capacity and level of service:

Capacity of any particular area or junction can be described as whether the present traffic is being accommodated by the present condition of the road without much difficulties. Certain conditions arise where the capacity of the selected stretch is very less thus leading to various problems like congestion and delay.

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Level of service can be described as the how well the junction is meeting the requirement and whether the vehicle are being affected by the prevailing condition. This parameter mainly helps in identifying the where does a particular junction stands in case of handling of the traffic and its behavior for the same. This can be grouped under the SIX category they are as follows

- LOS A : It indicates a free movement of vehicles without any obstruction or congestion
- LOS B ,C,D,E : these all indicate the intermediate flow of vehicles for the same
- LOS F : where the movement of vehicle is in worst scenario , thus leading to more amount of delay and conjunction this depicts the worst condition existing in the field

The study area which is selected, has a jammed condition and it exhibited the level of service as either E or F. Hence a great amount of detailed study is carried out to read the prevailing condition and find the loop holes and rectify the same in order to eradicate the existing condition. There are numerous factors which effect the level of service, for example traffic condition, roadway condition etc.

All the junctions were analyzed and evaluated with regard to all the parameters and same was analyzed by using different models and values obtained where compared for the same and simulated and validated to obtain the pertaining conditions

B. Intersection flow characteristics

In case of a signalized intersection three phase system exist red, green and amber. Each signal phase varies from different locations in certain place the green phase may be considerably high and lead to clearance of traffic and thus it indirectly effects the other leg of the intersection. The figure below represents the flow pattern in the signalized intersection which can be co related in the diagram fort the same. The figure below depicts the simple characteristics of the three phase system and thus it can be explained in the three parameters. In this, the first aspect indicates the time space meaning of the vehicle's class intervals for the signal cycle are depicted in the diagram. Second part gives us an idea about the time interval in that particular location. And the third part of the same aspect gives us the brief idea about the flow rate past it indicates saturation flow of the same condition.

C .Homogenous and Heterogeneous traffic flow

Homogenous type of traffic flow is considerably seen in the certain countries like US, UK where they follow a lane system and it consists of homogenous class of vehicle composition. Where as in India it consist of different class of vehicle playing on the road with different characteristics in there attribute like speed, dimension etc. Headway determination in this condition will be a troublesome by disrupting the traffic. In case of heterogeneous traffic lateral movement is considerably high same is not so in condition of the homogenous traffic

D. Lane Grouping

In a signalized intersection lane grouping will be a key aspect since number of vehicle moving in particular lane and weaving action needs to be given consideration .lane grouping is to be carried out for best results for the study

A separate indusial left lane can be given in required condition. In some places each segment itself consists of different grouping of vehicle movement

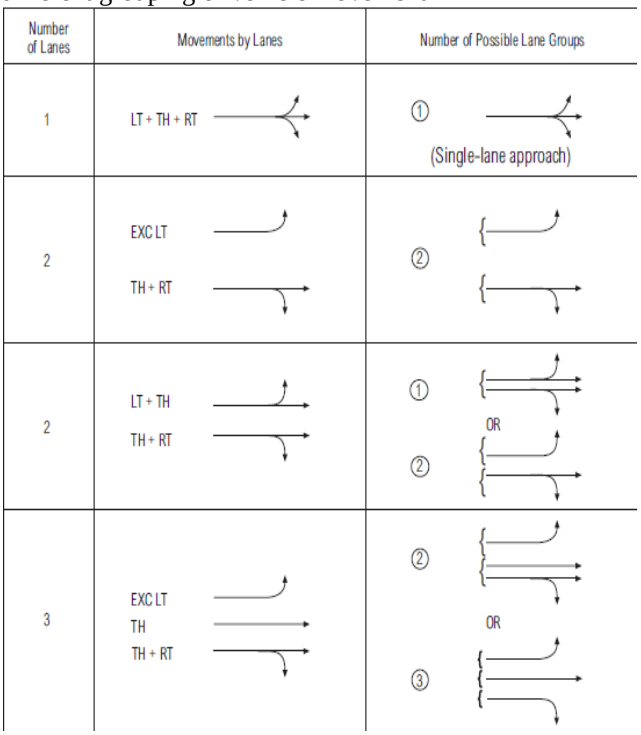

Figure 6: Lane Group Used In Analysis

E. Saturation flow rate

The figure below gives us a naked description of the saturation condition in the field during green phase and vehicle movement for the same

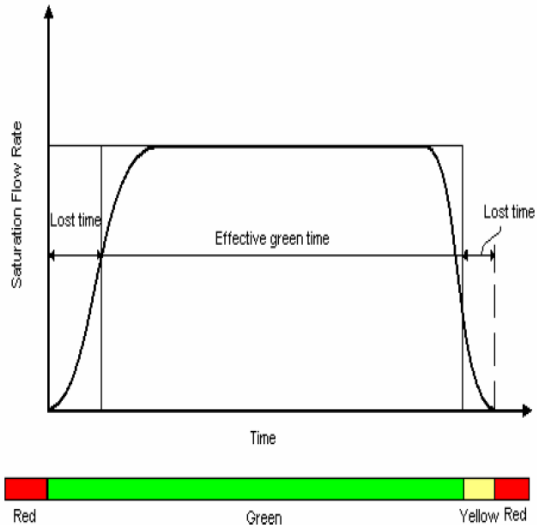

Figure 7: Traffic Flow in Green Period

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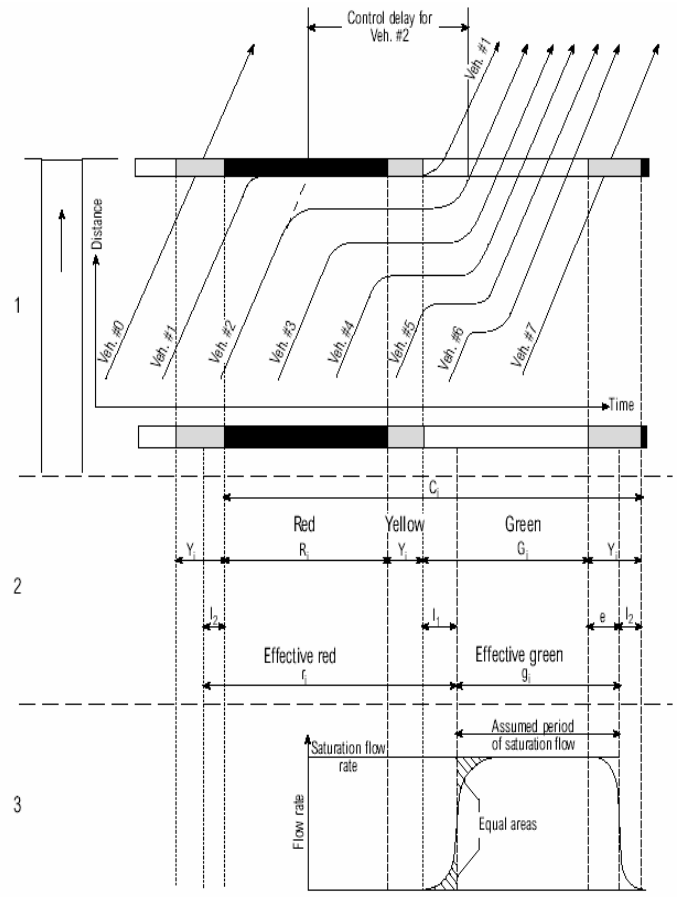

Figure 8: Flow Character of the Signal

IV. DETERMINATION OF PCU VALUE

In India traffic consists of different categories of vehicles with different flow characteristics and different speed and size. A heterogeneous type of flow is being absorbed in the field of Indian cities. Where it is required to convert the obtained values into a uniform value by converting it to a standard value that is Passenger car unit. Thus by doing so it helps in better perspective of calculation of the same regarding the requirement. Different categories of vehicle where noted down in the field for an interval of 15 min duration and for three hours in the morning and evening during two weekdays and two weekends. Same data had to be converted to a uniform value.

PCU values are calculated by using the Chandra's and Kumar method, where the mean speed of the vehicle of particular class car is calculated and it is divided to the space occupancy in the field so as to obtain the uniform values. Mean speed of different vehicles have been noted down in the field either by time mean speed or space mean speed method and it is used along with the area occupied by the particular class of vehicle .

TABLE 1: Vehicle Projected Area Used In Calculation of PCU

Vehicle category	Dimensions (m)		Projected area (m^2)
	Length	width	
Car	3.72	1.44	5.39
Two wheelers	1.87	0.64	1.2
Auto (three wheelers)	3.2	1.4	4.48
Bus	10.1	2.43	24.74
Truck	7.5	2.35	17.62
LCV	6.1	2.1	12.81
Trailer	7.4	2.2	16.28
Bicycle	1.9	0.45	0.85

Formula used to calculate by the recommended method is as follows:

$PCU = (V_C/V_I) / (A_C/A_I)$

V_C/V_I= speed ratio of car to ith vehicle

A_C/A_I= space ratio of car to ith vehicle

V_C=mean speed of car (km/hr.) A_C= projected area of car (m^2)

By using the above formula and using mean speed values of different categories of vehicle and relating it to the car value it was converted into the PCU value

Table 2: spot speed study data

Vehicle	Mean speed (km/hr.)										
	OKLIPURAM					TIN FACORY			KR MARKET		
	*O-M	MA – O	MA-M	M-O	O-MA	T-WH	WH-T	R-T	MY-SP	CO-MY	BMS-KR
Car	24.56	28.52	31.34	32.86	35.38	26.32	29.47	32.3	25.22	30.12	31.93
TW	27.66	32.52	35.67	38.65	42.22	29.34	33.64	36.5	28.54	34.28	36.12
Auto	22.57	25.46	29.48	31.22	33.65	23.46	27.35	30.2	23.12	28.14	28.67
Truck	15.22	18.52	20.52	22.48	-	16.38	18.47	20.8	17.48	21.45	20.75
Bus	16.38	19.46	22.48	25.44	30.78	22.52	22.47	25.3	20.12	23.84	25.17
Trailer	16.42	16.44	16.77	19.52	-	24.52	-	-	19.52	-	20.14
Cycle	13.48	15.34	15.83	-	22.35	-	-	-	18.69	19.12	
LCV	18.52	21.44	26.88	-	30.2	28.33	32.33	30.3	26.12	29.78	23.85

*O=Oklipuram, M=Majestic, MA=Malleshwaram, T=Tin Factory, WH=White Field, R=Rao Road, MY=Mysore, SP=SP Road, CO=Corporation circle, KR=KR market

Above table gives us the clear picture of the different mean speed values obtained for the different junction. Values obtained here are of different class of vehicles and it is used for calculation. Mean speed was calculated during peak hour of the day and both maximum and minimum speed was noted down and time mean speed as well as space mean speed method as used to obtain the relevant values .hence obtained values of PCU are given in the below table for the same after using it in the relevant formula

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Table 3: PCU values obtained by Chandra's method

Vehicle	PCU VALUES										
	OKLIPURAM					TIN FACORY			KR MARKET		
	*O-M	MA – O	MA-M	M-O	O-MA	T-WH	WH-T	R-T	MY-SP	CO-MY	BMS-KR
Car	1	1	1	1	1	1	1	1	1	1	1
TW	0.2	0.24	0.19	0.23	0.32	0.28	0.31	0.29	0.21	0.34	0.33
Auto	0.9	0.85	0.88	0.95	0.82	0.96	0.84	0.81	0.74	0.83	0.92
Truck	5.4	5.1	4.94	4.5	-	3.78	3.65	3.14	3.64	4.32	4.1
Bus	6.7	6.5	6.3	5.9	5.34	5.8	5.4	4.34	4.2	3.85	3.45
Trailer	4.5	5.2	5.6	5.4	-		-	-	4.9	-	4.75
Cycle	0.3	0.28	0.32	-	0.34	-	-	-	0.37	0.38	-
LCV	3.2	3.12	2.77	-	2.7	2.12	2.54	2.45	2.34	2.0	3.1

It can be observed from the above obtained values that certain categories of vehicles have comparatively higher pcu value than recommended by the IRC standard values. With regard to truck and bus its considerably higher where as other values are matching up to values as recommended for different locations. Same values were used to convert the whole volume of different categories of vehicle into one confined value. All the values obtained in the field are noted down into the excel sheet and same is used to multiply the values and get the final results of the peak hour in terms of required parameter .An example of the calculation carried out is being represented in the figure below of a particular junction same was carried out for other locations to get the required outcome.

A. Determination of saturation value

Saturation flow refers to number of vehicles passing to the maximum value during the peak green phase of signal. Saturation flow parameter is an important aspect with regard to development and understanding of the capacity of the particular intersection and it also helps out in designing of signal cycle length for the easy flow of traffic.

The saturation flow data in one intersection was obtained by means of videographer survey where as in certain points due to constrains it was measured manually either in veh/hr. or pcu/hr. Headway method of calculation of the saturation value does not hold good here because of the heterogeneous condition prevailing in Indian cities and it would disrupt the traffic as well as overall calculation would be tedious. Hence data was obtained by manual calculation, the no of vehicles passing the reference point. The steps involved in this process is described below as follows.

- Initially a referral point usually pedestrian crossing line /zebra line is considered as the noting point
- Same can be used to calculate and note down the no of vehicles crossing the reference line after first three seconds of green phase
- Initially first three sec of the green phase is neglected and after that the number of vehicles crossing the same in green saturation time is noted and final value is obtained by dividing the no cycles being carried out fort the same
- Importance is given in order to note down the number of vehicles making the left turn as well right turn if any
- In case of video graphic method it would be repeated several times to obtained the required data which would be a time consuming process

Saturation value obtained is shown below in the table for the same

Table 4: cycle timing and percentage turning movement of traffic

Intersection	Width (m)	Cycle time (sec)	Green cycle (sec)	% Right turn	% Left turn	% Through
Oklipuram	8.02	250	195	90	10	0
Malleshwaram	8.10	198	120	85	0	15
Majestic	5.6	198	120	-	100	-
Tin factory	12	221	50	12	-	88
Whitefield	9.07	170	125	18	9	73
Rao road	7.81	137	57	20	80	-
Mysore road	9.66	225	145	5	5	90
Corporation road	8.5	130	50	35	0	65
BMS college road	6.94	195	50	40	60	-

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Table 5: saturation value calculation

No of cycles	First 25 sec	Second 25 sec	Third 25 sec	Forth 25sec	Fifth 25sec	Sixth 25 sec
1	29	25	22	19	25	25
2	25	24	35	33	25	24
3	14	18	12	32	15	17
4	22	11	28	21	22	18
5	12	14	26	28	12	17
6	11	15	18	25	23	22
7	12	25	22	19	32	31
8	14	32	12	15	18	20
9	18	22	12	13	13	12
10	17	13	14	35	29	18
11	22	22	19	11	12	22
12	24	48	22	11	14	35
13	29	34	27	16	15	28
14	13	55	24	13	19	19
15	24	26	14	12	24	13
16	14	29	15	14	35	31
17	17	35	18	19	25	10
18	15	39	32	28	12	14
19	14	19	24	21	18	11
Total	346	506	396	385	388	377

Observed saturation = (No of vehicles counted during saturation period) / (Total no of samples)
S= (346+506+396+385+388+377)/19*6*25
S= 2398/2850
S=0.84140 veh/sec
S= 0.84140*3600 = 3029 veh/hr.
Saturation flow value of different junctions are calculated and it is being tabulated below for the same for different locations as described in the above procedure which is helpful in determining the various aspect

Table 6 : saturation flow value obtained

Intersection	Saturation flow (veh/hr.)
Oklipuram	3152
Malleshwaram	3485
Majestic	2850
Tin factory	3585
White field	3100
Rao road	3423
Mysore road	3029
Corporation road	3413
BMS college road	3120

Traffic vehicle composition as recorded in the video graphic or manually of different class of vehicle in selected junction of study is shown by means of pie charts describing the percentage of different class of vehicle.

B. Capacity calculation and v/c ratio

Capacity at any particular signalized intersection depends upon the saturation flow rate of that particular area during the saturation green time of the cycle length. The capacity of any particular lane can be calculated by the given formula

C=S*(g/c)

Where,

C = capacity of the selected lane

S = saturation flow (vehicles/hour)

g/c = green cycle effective ratio

Vehicle to capacity ratio is also an important parameter to know the whether the condition is over saturated or under saturated for the same condition

Degree of saturation X=V/C

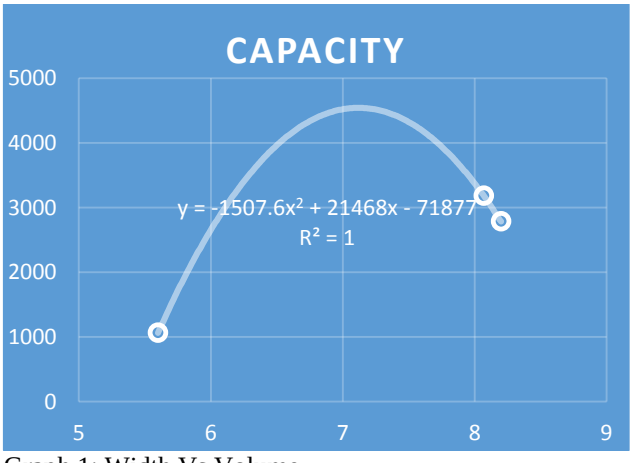
Where, V=volume (vehicles/hour)

C=capacity (vehicles/hour)

Speed volume relation can be used to obtain the capacity value. Each categories of vehicle has different speed and it leads to generation or formation of different capacity of selected location. By plotting graph between width and volume we can get the theoretical capacity from developed equation

Table 7: Observed and Theoretical Capacity

Location	Width (m)	Observed capacity(pcu/hr)	Theoretical capacity
Oklipuram-Majestic	8.07	3182	3187
Malleshwaram - oklipuram	8.2	2784	2790
Majestic - oklipuram	5.6	1064	1066



Graph 1: Width Vs Volume

$S= -1507.6X^2+21468X-71877$ ……equation (1)

The above equation obtained by plotting the respecting value can be used to calculate capacity.

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C. Delay values are calculated by means of HCM 2000 manual method

As per HCM manual stopped delay controlled delay and overall delay is being calculated and LOS is determined .The different delay values obtained for different junctions which are given in the table below and it is tabulated based on segment travel time. The value is being used to validate by microsimulation using VISSIM software.

Table 8 : level of service of different junction

Intersection	Arrival type (AT)	Urban street class	Free flow speed (FFS)	Running time (RT)	Uniform delay D_1	Incremental delay D_2	Control delay $D=D_1+D_2+D3$	LOS segment	LOS urban class
O - M	III	III	55	44	51	22.6	81.767	F	
MA - O	III	III	55	44	25.5	1.4	17.64	E	
MA- M	III	III	55	44	19	0.34	38.37	D	E
M-O	III	III	55	44	26	1.5	72.34	E	
O--MA	III	III	55	44	19.12	0.34	38.372	D	
T-WH	III	III	55	44	87.56	177.79	409.23	F	
WH-T	III	III	55	44	18.46	10.07	75.229	E	E
R-T	III	III	55	44	25.892	0.453	84.183	E	
MY-SP	III	III	55	44	33.086	13.45	115.01	E	
CO-MY	III	III	55	44	34.11	3.56	107.84	E	E
BMS-MY	III	III	55	44	73.386	106.93	211.57	E	

V. MICROSCOPIC SIMULATION IN VISSIM

A. General

Microscopic simulation using VISSIM will help in determining and validating the different values obtained in the field as well as we can analysis whether the condition prevailing is true to what extent. This software help us to better understand the existing condition and suggest some improvement measures for the same.

This model helps in tracking and simulating certain indusial class of vehicle in particular stretch .vehicle can be tracked using the network generated in the VISSIM software and various data can be collected by establishing the data collection points in the parameters any type of traffic condition can be analyzed whether it is oversaturated or under saturated existing condition. Since each class of vehicle can be tracked here different set of delay values arises in the field even segment travel time, queue length generated and position of vehicle as well as vehicle travel time .an advancement in the field of transportation engineering is brought about by this type of software depicting the existing condition and what measures can be taken to overcome the same

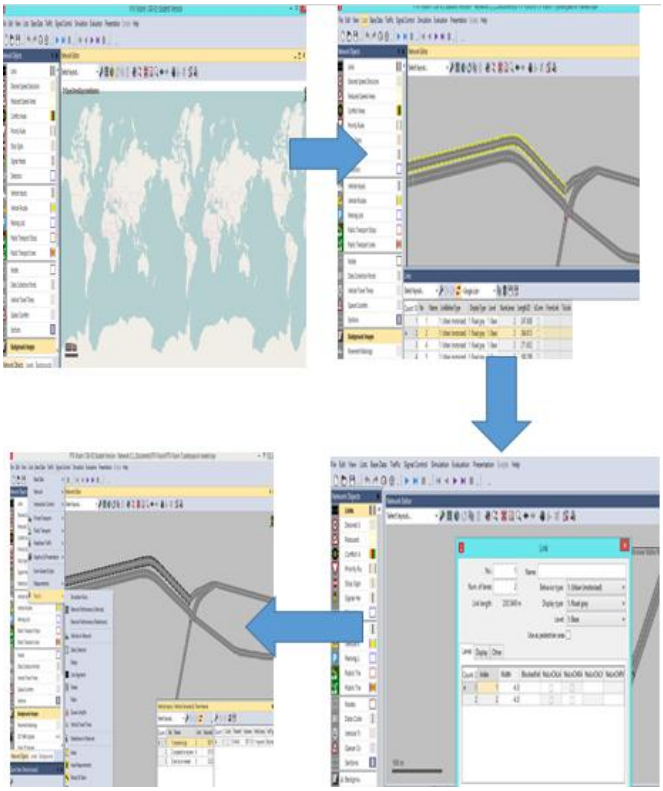

Figure 9 : steps involved in VISSIM

B. VISSIM Results

Oklipuram junction

Table 9: Vehicle Travel Time

Location	Vehicle travel time
O-M	141.96
M-O	304.70
O-MA	139.54
MA-O	165.39
MA-M	146.86

O=Oklipuram, M=Majestic, MA=Malleshwaram, T=Tin Factory, WH=White Field, R=Rao Road, MY=Mysore, SP=SP Road, CO=Corporation circle, KR=KR market

Table 10: Delay and Speed value

Location	Q length	Queue max
Oklipuram	97.55	122.91
Malleshwaram	106.11	208
Majestic	92.66	145.89

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Table 11: Queue length

Location	Queue delay	Speed
Oklipuram –Majestic	58.52	18.59
Malleshwaram –oklipuram	65.17	25.64
Malleshwaram – majestic	147.59	27.21
Oklipuram –Malleshwaram	65.17	25.64
Majestic to oklipuram	147.59	27.21

Tin factory junction

Table 12: Various results obtained in VISSIM

Location	Vehicle travel time	Queue delay	Speed	Q length	Q max
Tin factory	449.128754	298.197968	25.298048	317.849609	511.535614
Whitefield	282.471283	129.754105	25.986189	187.91449	324.162262
Rao road	370.958099	306.242584	28.467363	109.31955	131.733658

KR market

Table 13: Values of KR Market

Location	Vehicle travel time	Queue delay	Speed	Q length	Q max
MYS-SJP	611.741638	176.787872	24.655922	313.116699	392.045 99
CO-MY	215.732635	44.396915	26.109312	152.440002	277.670166
BMS-MYS	279.1008	169.387604	24.8594	120.295242	158.359375

It was seen that results obtained due to micro simulation was matching to the obtained data in the field to an accuracy of 90 % and all the parameters where crosschecked to validate the model for the same even level of service and queue length of various segment was correct to the nearest value calculated in the field . This micro simulation has given a satisfactory result for the given condition and matched up the all the constrains and even the validation was up to the mark delay results obtained due to micro simulation also matched to the great extent depicting the same level of service in study area

Table 14: queue delay and speed of selected junction after improvement

Location	Queue delay	Speed
Oklipuram -Majestic	58.52	18.59
Malleshwaram –oklipuram	65.17	25.64
Malleshwaram – majestic	147.59	27.21
Oklipuram -Malleshwaram	65.17	25.64
Majestic to oklipuram	147.59	27.21

Oklipuram junction

In this particular location it can been seen that the level of service is in its worst prevailing condition with maximum number of vehicles since it is near to the CBD area majestic

FIGURE 10: FLYOVER 3D MODEL IN VISSIM

VI. PROPOSAL FOR IMPROVEMENT

A. *Oklipuram junction*

In this particular location it can been seen that the level of service is in its worst prevailing condition with maximum number of vehicles since it is near to the CBD area majestic. More number of vehicles do pass in this particular stretch of road. Hence certain proposed to overcome and reduce the queue length obtained in the field and considerably reducing the overall delay condition

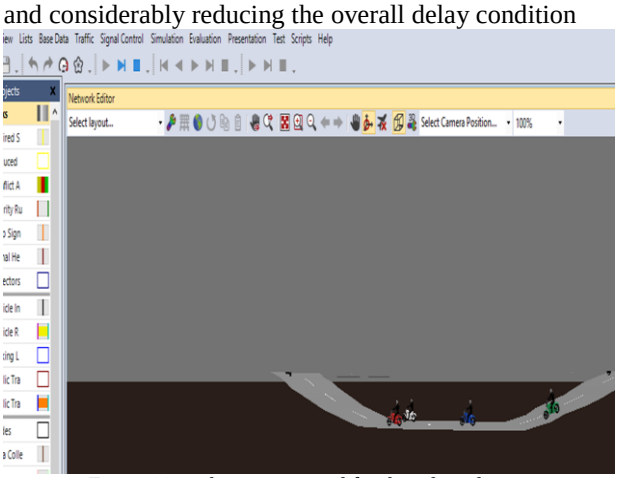

Figure 11: underpass proposal for the selected junction

Table 15: Flyover Results Queue Length

Location	Q length	Q max
Oklipuram	98.077316	122.373093
Malleshwaram	0.247362	48.567478
Majestic	93.092453	146.279877

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Table 16: Underpass Vehicle Travel Time

Location	Vehicle travel time
O-M	65.119507
M-O	290.509033
O-MA	65.098358
MA-O	64.65226
MA-M	160.197296

Table 17: Queue Delay and Speed in Improved Condition

Location	Queue delay	Speed
Oklipuram -Majestic	1.701185	22.961836
Malleshwaram – oklipuram	21.82173	26.053631
Malleshwaram – majestic	154.37233	27.378853
Oklipuram - Malleshwaram	21.82173	26.053631
Majestic to oklipuram	154.37233	27.378853

B. Tin factory

LOS obtained here in this junction was considerably high as of E which states a poor vehicle movement and more number of delays. Here it consists of large number of goods vehicle and more number of motor vehicle. Location being near to the railway station more number of commuters and pedestrian disrupt the traffic while movement and sometimes it has led to increase in large queue length and high amount of delay in selected segment.

Table 18: Improved Values of Tin Factory

Location	Vehicle travel time	Queue delay	Speed	Q length	Q max
Tin factory	524.225952	349.649475	23.981705	325.939209	511.401154
Whitefield	182.544373	27.641062	25.666513	153.399323	324.925232
Rao road	389.091187	314.502808	26.985277	108.618896	131.750244

C. KR market

It is one the largest flower market in Asia it consists of huge number of pedestrians and large categories of heavy vehicle making the existing condition to a worst level of service and delay is common condition in this junction and it leads to more queuing up of vehicle where manual controlling of traffic sometimes arises in this condition hence I have suggested and corrective measure of an underpass for this junction in order to improve the condition of the same

Table 19: KR Market Decrease in Queue Length

Location	Vehicle travel time	Queue delay	Speed	Q length	Q max
MYS-SJP	210.645386	176.787872	24.655922	-	-
CO-MY	309.189514	44.396915	26.109312	85.565598	270.234955
BMS-MYS	222.850266	169.387604	24.8594	85.325676	155.76091

VII. CONCLUSION

This paper drawn to certain conclusion after the results is as follows:

1. For an accurate results video graphic survey was carried out in one junction and remaining manually calculation was carried out it was found that recorded data gives accurate results and can be stored as the data for future reference
2. In case determination of the PCU values in mixed traffic condition by Chandra's method it was found out that values were matching to IRC and some higher than recommended
3. Calculation of saturation flow by HCM manual method initial 3sec of green time was neglected to prevent the effect of startup vehicle lost time. heterogeneous traffic makes it a tuff task
4. Turning traffic had to be given important since it is key parameter in the determination of saturation follow
5. A graph was plotted between width and volume to calculate the observed and theoretical capacity which matched to a great extent.
6. Delay values obtained by HCM method depicts a near accurate results and prevailing in present existing condition
7. Validation and results obtained by micro simulation was matching up to a great extent and it can be observed visually
8. After proposal of improvement delay ,vehicle travel time , queue length was reduced Overall VISSIM model gives the exact picture of the same condition
9. It can be absorbed that all the relevant LOS of all the selected area of study should improvement in LOS to C or B after proposal of improvement

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