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Evaluation of Vehicle Conflict at Uncontrolled Intersection-A Case Study at Yelahanka Raitharasanthe Junction

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Abstract

This study examined the impact of uncontrolled intersections on vehicle drivers at intersections. Initially, preliminary analyses were conducted to determine the vehicular traffic and the Volume of the automobiles. This paper focuses primarily on the traffic analysis of various different kinds of vehicles volume, as well as the computation of PCU values and areas where vehicles can be conflicted. Three days of flow rate were gathered in the selected study region, as traffic increased day by day on a peak and non-peak hour basis. Different traffic data analysis using traffic volume count, speed data such as spot speed, speed and delay, time mean speed and space mean speed were calculated and find the relation of flow parameters as per the traffic movement. To identify traffic conflict in the study area, volume counts in each path of the intersection were performed to determine the study location conflict area. This paper can be used to study vehicle travel patterns at crossing points for future development of the study area's junction.

Keywords: *PCU, Intersection, Conflict*

INTRODUCTION

Road user safety is a major concern for both developed and developing countries because it affects the economy and people's welfare. Between 2006 and2016, the total number of registered motor vehicles in India increased at a compound annual growth rate (CAGR) of 9.9%. Amongst various vehicle categories, two-wheelers, cars, jeeps, and taxis had the

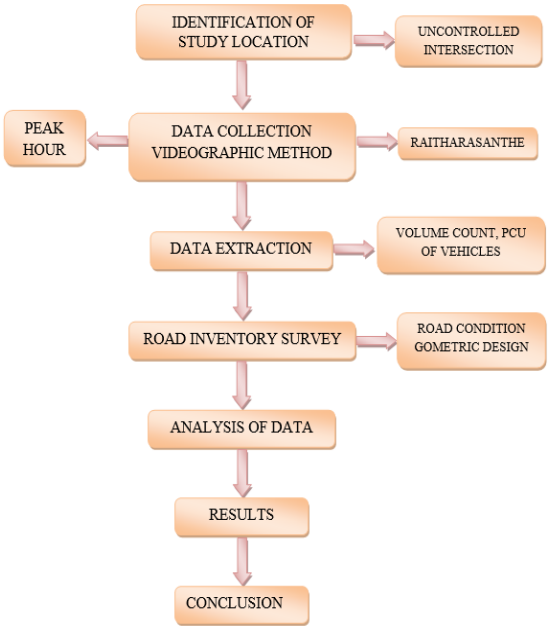
highest CAGR of 10.1% each. In 2016, two-wheelers had the highest share of the vehicular population (73.5%), followed by cars, jeeps, and taxis (13.1%), other vehicles (8.1%), goods vehicles (4.6%), and buses (0.8%) (MORTH 2017). Continuous economic growth and rising per capita income have fuelled India's rapid expansion of motorized vehicles. Vehicular risks have increased exponentially as a result of rising population and rapid vehicular growth, particularly in developing countries such as India, where existing road infrastructure is unable to accommodate the increasing traffic. Road accident is a major threat which accounts for huge loss of lives and cost to a society. They claim an average of baby every three minutes and 3000 lives every day (Mittal 2011), which has increased safety awareness globally. To enhance road safety, the United Nations has declared the decade of 2011- 2020 as the road safety decade thus increasing the importance of Road Safety Analysis (RSA). This is a preventive measure designed to identify potential safety issues for all road users and ensure that solutions to eliminate or reduce the issues are fully considered. India has the world's third largest road network, with a recent surge in the construction of highways and rural roads. Several road development programmes have been launched. It is essential to use predictive methods to estimate the impact of different safety precautions on the traffic system in order to improve the traffic safety scenario through the development of infrastructure as well as safety features in vehicles. Due to rising income levels and insufficient, inefficient public transportation services, motorcycle and car ownership has become more affordable, resulting in a shift from public to private transportation. As per a 2017 report on road accidents in India, the age groups 18–34 ages and 18–60 ages accounted for 48 and 85 percent of total road accident fatalities, respectively. In addition, 47 percent of all road accident on other district roads, with 39 percent occurring at junctions and 72 percent occurring at uncontrolled intersections. Henceforth, road user safety at un-signalized intersections must be prioritized, and research must be conducted considering, different aspects of roadway geometric conditions, traffic characteristics, and road user behaviour, as well as vehicular stream characteristics, in order to improve overall facilities for all types of road users and reduce various factors that cause road accidents. Vehicles colliding at intersections are usually caused by merging, crossing, and diverging vehicles, as well as abrupt

changes in speed and unexpected lane changes. Bicyclists and two-wheelers are thought to be the most collision-causing elements at such uncontrolled intersections, accounting for nearly 45% of total fatalities recorded thus far. An examination of traffic accident findings at high-accident crossings revealed that the numbers reported of any given type of accident scenario were insufficient for adequate analysis. Moreover, it was felt that it should be possible to objectively assess a given area's accident potential—to evaluate an intersection dynamically rather than waiting for an accident history to develop.

A traffic conflict is any situation that could result in an accident; there are two types of traffic conflicts evasive driving and traffic violations. A preliminary analysis of conflict and accident data has been completed. It was discovered that the possibility of a conflict situation resulting in a reported accident is largely determined by the relative approach speeds of the clashing vehicles, as well as other factors such as road geometry and environment.

It should be noted that the issue of unreported accidents is extremely important when attempting to relate evaluated dispute frequencies with reported accident frequencies. Bangalore topped the list of cities around the world, with Mumbai, Pune, and New Delhi placing fourth, fifth, and eighth, respectively. Because of the broad range in their physiological and going to operate qualities, the connection of different categories of vehicles along the street causes numerous issues to traffic specialists and organisers during mixed rush hour gridlock conditions. The difficulty of population connectivity has given rise as the city's population has grown and enlarged.

METHODOLOGY



Identification of Study Location

Study location Selection was based on the high-rate movement of vehicles, and the

location where the junction is uncontrolled without signals and unmanned control junctions. And also, during the movement of vehicles, pedestrian makes a disturbance to the easy flow of vehicles because of the movement in uncontrolled Intersections the vehicles driver lose the concentration on road, due to these accidents are caused.

Before selection of the study area a survey was done by collecting the accident data of previous three years by respective traffic police stations which are namely Hebbal traffic police station and yelahanka traffic police stations. After the collecting the data from traffic police stations, study location was selected and that location was uncontrolled and due to this accident were taking place.

Yelahanka was selected as the study location, which is present in Bangalore city, based on the data collected by traffic police stations, but I was searching for the area which should not have signals or controlled by traffic police for the easy flow of vehicles.

Uncontrolled Intersection

The road interconnection occurs when two or more roads intersect or pass at grade. This busy intersection accommodates all forms of transport: bicyclist, scooter, heavy truck, and transit. As a result, the intersection generally includes not just pavement, area but also the adjacent sidewalks.

On any highway, traffic major intersections are complicated locations. It is because vehicles travelling in opposite directions would like to occupy same region of space. At a crossroads, motorists must end up making split-second decisions based on their route, intersection geometry, the speed and direction of many other vehicles, and so on. After the process of Identification of location, the process is now to select the area where there is no signal, uncontrol or any other restrictions for the easy flow of vehicles without any disturbances.

After visiting many intersections, Raitharasan the has been selected as the intersection, which is situated in yelahanka, Bangalore.

Data Collection

Data collection is a process of assembling data on different factors of interest in a systematic manner that allows one to assess the values that are useful in locating or obtaining the desired values. Information is collected at a few places

selected to represent activity, transport movement, and vehicle traffic across the whole study area or a sample of various types of vehicles captured during the data collection process. After the process of Selection of study location, the second step in methodology is to collect the data from the study area.

Data collection is done with the help of camera, by recording the data, in the study location with the help of camera the movement of vehicles was captured, movement of different types of vehicles such as 2-wheelers, Cars, Buses, Lcv (light commercial vehicles), Heavy vehicles, and Autos. The process of videography was done on the two roads that is from baglur to hebbal and from hebbal to baglur the videography was done for eight hours on each road for 3 days. It was from morning 8am to 12pm and from 3pm to 6pm for continuously 3 days. Three days are from Thursday, Saturday, and Monday respectively.

The collection of video data from the study area was done and after the collection of video data from the videography method it was extracted. In videography of the selected study area the movement of different types of vehicles were observed and also it was done during peak hour and nonpeak hour the video data was collected. The videography was done at the Raitharasan the intersection where movement of vehicles was more, and it is an uncontrolled intersection.

Fig 1: Uncontrolled Intersection

Fig 2: Traffic Jam at the Intersection

Data Extraction

After the process of collecting the data from the study location, the data which was collected from the study location should be extracted. Extraction of data is nothing but the process of volume count of different types of vehicles. In the process of volume count of vehicles different types of vehicles where present and they were 2-wheeler, Cars, Buses, Heavy trucks, Autos and Lcv (light commercial vehicle) respectively. Extraction of data was done for three days of data after the data extraction procedure. Total volume of different vehicles was done to understand the flow pattern. Here condition of road was observed by visiting the study location and also the geometric features of road were also observed which helps further for the improvision of road condition in the future. Data extraction was done for 8 hours on each direction of road, it was done for the time interval of 15 min, and it was done for 8 hours on both the directions of road.

Road Inventory survey

After the process of data collection and extraction of data, road inventory survey was done, in this survey carriage width, Right of Way (ROW), Footpath Condition, Kerb height survey was done by visiting the study location. Measurement of kerb height, carriage width, right of way was done. This helps to improve the condition of road based on the movement of vehicles and by which reduction of accident can be occurred.

Analysis of Data

Analysis of data was done after the process of road inventory survey, here in the

process of analysis data extraction is first carried out and after the process of data extraction volume count of vehicles was done, volume count was done for all the three days data. In the process of volume count total number of different vehicles was calculated. After the process of total volume count of vehicles, passenger car unit of all the different vehicles were calculated here total pcu was done for all the vehicles which are considered during the process of data extract. Then reconnaissance survey was conducted to find the carriage width, right of way, kerb height, footpath width. Spot speed study was done for more than 120 vehicles after the process of spot speed, speed and delay was done than comparison of all the three days data was carried out. Then with the help of Spot speed data time mean speed and space mean were calculated and after all these calculation densities of vehicles was calculated with the help of time mean speed. Peak hour volume was also calculated after the process of total volume count.

Passenger Car Unit

The different vehicles have different dimensions and acceleration, to make the analysis easy all vehicle characteristics are converted to passenger car. The PCU values changes for every parameter of road characteristics such as road width, shoulder width, roundabouts, directional split etc.

Table 1: Table shows different vehicles PCU values

SL NO	VEHICLE TYPE	PCU EQUIVALENCY FACTOR
1	Motorcycle	0.5
2	Car	1.0
3	Auto Rikshaw	1.0
4	Bus	3.0
5	2 Axle Truck	3.0
6	3 Axle Truck	3.0
7	Multi Axle Truck	4.5
8	Agricultural Trucks	4.5
9	Animal Drawn Cart	6.0
10	Hand Carts	3.0
11	Cycle	0.5

SURVEY AND DATA COLLECTION

Survey

The survey was conducted at the banglore city where traffic is more, and it leads to the clashes of vehicles. I have chosen banglore as the city to do the survey of vehicles, because of more movement of vehicles and more accidents takes place. I have chosen the study area as Raitharasanthe which is located in the yelahanka new town present at the north of banglore where movement of vehicles is more and accident rate is high, because of more uncontrolled intersection present at the north of banglore city. Before selection of the study location, I have collected the data from various traffic police stations; data was collected from the previous three years. It consists of number of accidents in that particular area and the blackspots where more accidents take place. While the selection of study location I have almost travelled all the blackspots and selected the study area. I have selected study location based on the uncontrolled intersection and more movement of vehicles.

Data collected from the traffic police stations gives the number of accidents took place in particular area and the blackspots where a greater number of accidents occur.

Data Collection

Data collection is a process of assembling data on different factors of interest in a systematic manner that allows one to assess the values that are useful in locating or obtaining the desired values. Data collection of different types of vehicles was carried out with the help of camera at the intersection, which is uncontrolled.

Traffic Data (Accident Data)

Data collection was done at two traffic police stations namely hebbal traffic police station & yelahanka traffic police stations. Data collected in a police station was regarding the number of accidents which takes place in their respective areas. With accident data number of fatal and nonfatal data was also provided and blackspot present in respective areas were collected.

Yelahanka traffic police station has five blackspots which comes under their jurisdiction namely -

1. Jakkur Aero Drum flyover
2. Coffee day
3. Palanhalli Gate
4. IAF Gate
5. Puttanhalli Yelahanka traffic police station data

Table 2: It represents the number of accidents took place in the area of yelahanka

YEAR	NUMBER OF ACCIDENTS
2019	108
2020	43
2021	25

Table 3: It represents number of accidents took place in the area of hebbal

YEAR	NUMBER OF ACCIDENTS
2019	35
2020	20
2021	18

Reconnaissance Survey

After the process of collecting the data from traffic police stations, reconnaissance survey was done at the study location. In this survey. Geometrical road features were collected for the purpose of analysis.

Route	Right of Way	Carriage Width	Kerb	Footpath	
				Left	Right
Baglur to Hebbal	20.16 m	13.66 m	0.15 m	2.2 m	Absent
Underpass	10.4 m	6.93 m	0.18 m	1.42 m	1.42 m
Hebbal to Baglur	12.65 m	9.75 m	0.18 m	Absent	1.5 m
Towards old town	21.39 m	16.75 m	0.25 m	1.98 m	2.1 m
Towards Raitharasan the market	16.62 m	10.96 m	0.15 m	1.92 m	1.74 m

Fig 3: carriage width at underpass

Fig 4: Carriage and Footpath Width

Volume Count

It is the process to calculate different types of vehicles total & to calculate hourly based volume and total pcu values based on the hourly count of the vehicles. Volume count was done for different types of vehicles such as 2-wheelers, Cars, Lcv (light commercial vehicles), Heavy vehicles and Buses.

Table 4: It is the sample volume count which shows different types of distributed vehicles on Saturday from Hebbal to Baglur.

Right= Towards Raitrasanthe Left= Towards Old Town

Timing	2-Wheeler	Autos	Cars	Lcv	Heavy Trucks	Bus	Total Vehicles	PCU Volume/hr
8.00-9.00AM	471	341	412	232	92	81	1629	2034
9.00-10.00AM	732	626	644	201	94	64	2361	2565
10.00-11.00AM	981	714	637	224	77	68	2701	2783
11.00-12.00PM	722	640	536	262	39	73	2326	2626
3.00-4.00PM	402	387	426	219	103	64	1601	2010
4.00-5.00PM	463	426	473	206	83	73	1724	2150
5.00-6.00PM	552	538	571	200	90	86	2037	2370
6.00-7.00PM	569	620	596	212	98	80	2175	2517
Total	4892	4292	4295	1756	676	589	16554	19055

Spot Speed Studies

The purpose of a spot speed study is to determine the speed of a stream of traffic at a particular location. The data collected with the spot speed studies is used to calculate the speed of the vehicle percentiles, which are useful in making a variety of speed-related decisions. Spot speed studies with mixed traffic flow were conducted near the junction for a distance of 100 meters. The distribution table is then created using the spot speed data, followed by the cumulative frequency distribution figure, and finally the appropriate values.

Table 5: It is the sample of spot speed data collected at the study area for (2-wheeler, Cars, Autos), from Baglur to Hebbal

		2-Wheeler		Cars		Autos	
No Of Vehicles	Distance	Time	Vel=(Dist/Time)	Time	Vel=(Dist/Time)	Time	Vel=(Dist/Tim)
1	100	15.5	6.452	17.31	0.373	18.12	0.021
2	100	9.56	10.460	16.09	0.650	22.12	0.029
3	100	8.8	11.364	11.74	0.968	15.5	0.062
4	100	10.62	9.416	20.08	0.469	15.99	0.029
5	100	12.6	7.937	18.03	0.440	18.44	0.024
6	100	11.57	8.643	17.15	0.504	15.1	0.033
7	100	11.25	8.889	16.14	0.551	13.45	0.041
8	100	13.34	7.496	15.8	0.474	18.44	0.026
9	100	10.8	9.259	13.58	0.682	14.57	0.047
10	100	14.24	7.022	15.87	0.442	17.59	0.025
11	100	11.45	8.734	18.14	0.481	13.54	0.036
12	100	8.95	11.173	21.28	0.525	22.3	0.024
13	100	10.57	9.461	16.46	0.575	10.55	0.054
14	100	10.12	9.881	20.42	0.484	15.55	0.031
15	100	11.28	8.865	10.73	0.826	14.8	0.056
16	100	12.8	7.813	11.87	0.658	11.57	0.057
17	100	11.78	8.489	14.95	0.568	11.95	0.048
18	100	9.85	10.152	12.74	0.797	17.94	0.044
19	100	11.25	8.889	13.78	0.645	15.84	0.041
20	100	19.58	5.107	14.79	0.345	19.78	0.017

Speed and Delay Studies

This survey assesses the quality of vehicular traffic along a route as well as the location, cause, and extent of delays along the same route. This enables the planners to make improvements. It could also be used to compare the before and after impacts of any improvement.

Speed and Delay Studies provide information such as the type of deferral, area, products, length, and recurrence of such postponements, as well as how to reduce postponements or speed up. We used the Floating Car Method for our study.

Table 6: It represents the sample collected data from the baglur to hebbal direction road, during speed and delay studies.

Baglur To Hebbal

No of Trips	Journey Time (Min)	Stopped Delay (Min)	Vehicles Overtaking	Vehicles Overtaken	Vehicles From Opposite Direction
1	10:21	4:40	24	8	225
3	12:33	5:37	31	11	263
5	14:29	6:45	27	6	295
7	9:53	4:31	19	9	247

ANALYSIS AND RESULTS

Spot Speed Analysis

Table 7: It represents the calculated values of the spot speed studies such as Range, Maximum value, and Minimum values in the collected data.

Route from Hebbal to Baglur

Range	Max	Min
8	11	3
NO of CI (K)	1+3.3LOGN	
n=	120	
LOGN	2.08	
3.3LOGN	6.861	
K=	7.861	
K=	8	
Class Size (I)= R/K	1.0	1

Table 8: It represents the calculated frequency, Cumulative frequency of spot speed study.

SL NO	Lower Limit	Upper Limit	Mid Speed	Frequency (no of vehicles)	% OF Frequency	Cumulative % of Frequency
1	0	2	1	0	0.00	0.00
2	2	4	3	16	13.33	13.33
3	4	6	5	67	55.83	69.17
4	6	8	7	20	16.67	85.83
5	8	10	9	15	12.50	98.33
6	10	12	11	2	1.67	100.00
				0		
				120		

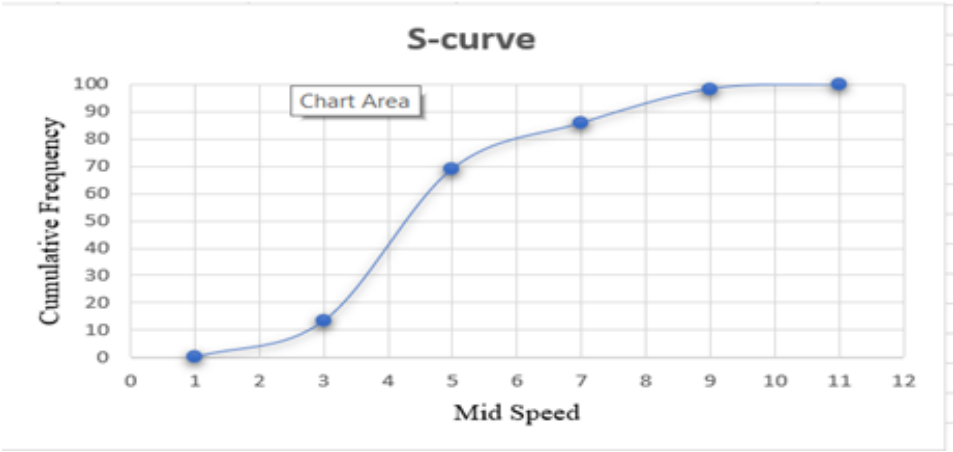


Fig 5: Cumulative frequency distribution diagram of Spot speeds

SPACE MEAN AND TIME MEAN SPEED CALCULATIONS

Space Mean Speed (Baglur to Hebbal)

DISTANCE = 100 M

Table 9: It represents the calculated percentile speed of the S-curve graph from the direction of hebbal to baglur

Percentile	Speed in m/s	Speed in kmph
15th	3.2	11.52
85th	6.9	24.84
98th	9.3	33.48

Vehicle Type	**No Of Vehicles**	**Travel Time (Sec)**	**Speed**
Two-Wheeler	20	14.23	100/14.23=

Cars	20	18.02	100/18.02
Autos	20	17.86	100/17.86
Lcv	20	22.74	100/22.74
Heavy Trucks	20	26.29	100/26.29
Bus	20	29.92	100/29.92

$$Vs = \frac{3.6dn}{\sum_{i=1}^{n} t1}$$

Vs=3.6*[(20x100)+(20x100)+(20x100)+(20x100) +(20x100) +(20x100) / (20x14.23) +(20x18.02) +(20x17.86) +(20x22.74) +(20x26.29) +(20x29.92)]= 16.73 kmph

Time Mean Speed

$$Vt = \frac{\sum_{i=1}^{n} vi}{n}$$

Vt= time mean observed

Vi= observed instantaneous speed of ith vehicles, mph

n=number of vehicles observed

Time mean speed: -Vt = [20(100/14.23) +20(100/18.02)+20(100/17.86) +20(100/22.74)+20(100/26.29) +20(100/29.92)]=[140.54+110.98+111.98+87.95+76.07+66.84]/ = 594.36 120 =17.83 kmph

Time mean speed and Space mean speed values are 16.73 kmph & 17.83 kmph respectively.

REGRESSION ANALYSIS

Baglur To Hebbal Direction Of Road On Thursday During Peak Hour

Table 10: It represents the calculated values of total vehicles during peak hour and Avg speed of different Types of vehicles.

Type Of Traffic Movement	Types Of Vehicles	Volume Of Vehicles	Avg Speed In M/S
	Two-Wheeler	776	7.55
Peak Hour	Cars	683	6.53
	Autos	593	6.43
	Lcv	321	5.76
	Heavy Vehicles	90	5.2
	Buses	67	4.53

Table 11: It represents the Calculated standard error, coefficients, P-value, where x and y are the two different variables to find regression analysis.

Dependent	Independent			
Y	X	Standard Error	Coefficients	P-value
Volume of Vehicles	Avg Speed of Vehicles	154.7395703	185.923865	0.016836031

As seen in the above table 5.15, it explains the values of standard error, coefficients, P-value of the vehicle movement during peak hour. By taking volume of vehicles as dependent variable and average speed of vehicles as independent regression analysis was done and the significant value is 0.016836031, hence p value is less than .05 (0.01683603 < 0.05) .

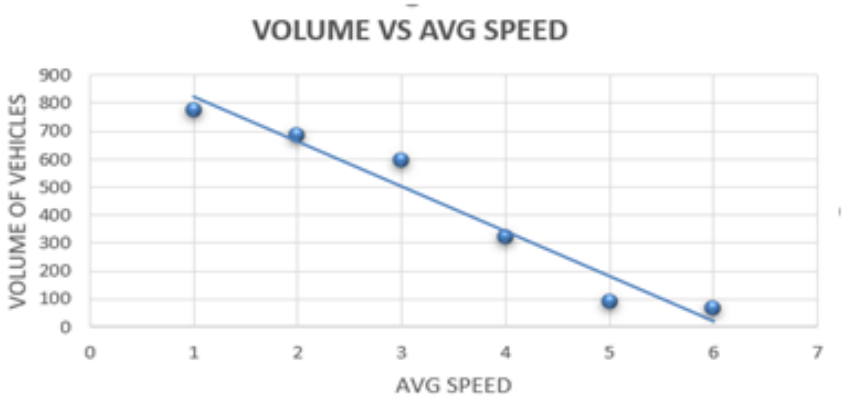


Fig 6: It represents the volume vs Avg speed of the vehicle, as speed increases number of vehicle decreases

Vehicle Composition Factors

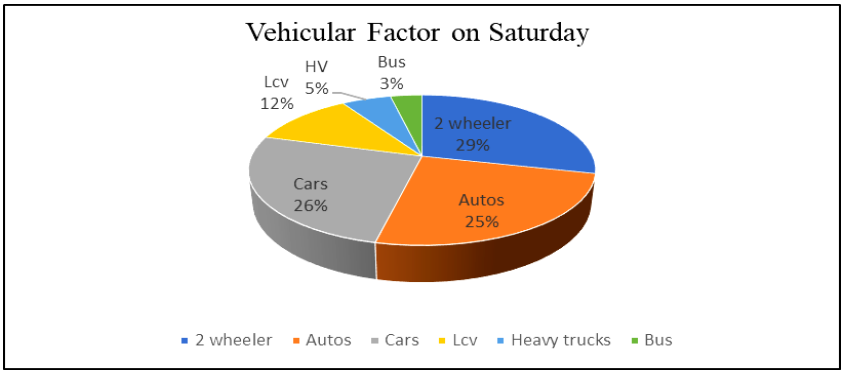


Fig 7: It represents the total number of movements of vehicles from the direction of Baglur to Hebbal on Saturday

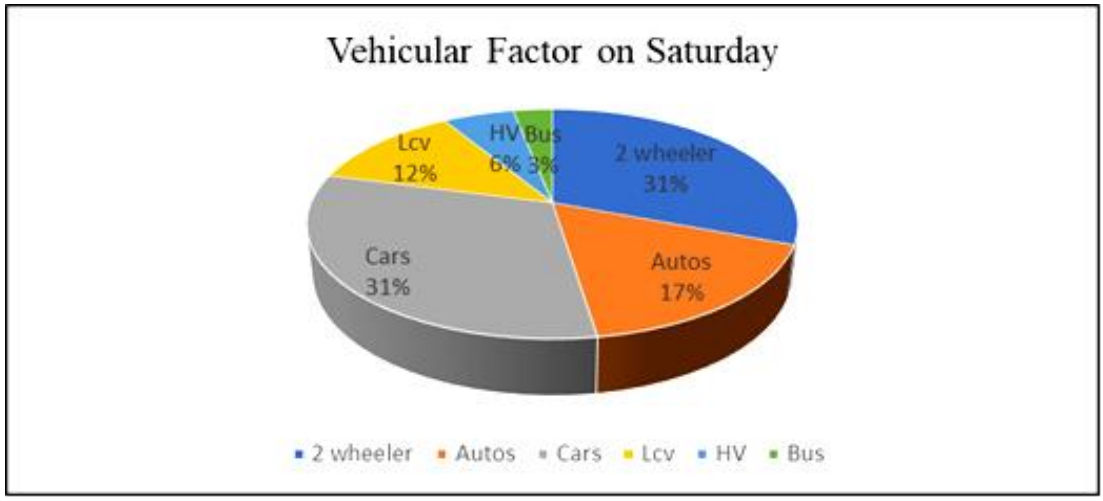


Fig 8: It represents the total number of movements of vehicles from the direction of Hebbal to Baglur on Saturday.

Conflict Points at the Study area

After the whole process, which is done at the study area, I have considered some of the conflict points which may affect the movement of vehicles from one direction to another direction. Mainly the rights turn which is from the direction of Hebbal to Baglur.

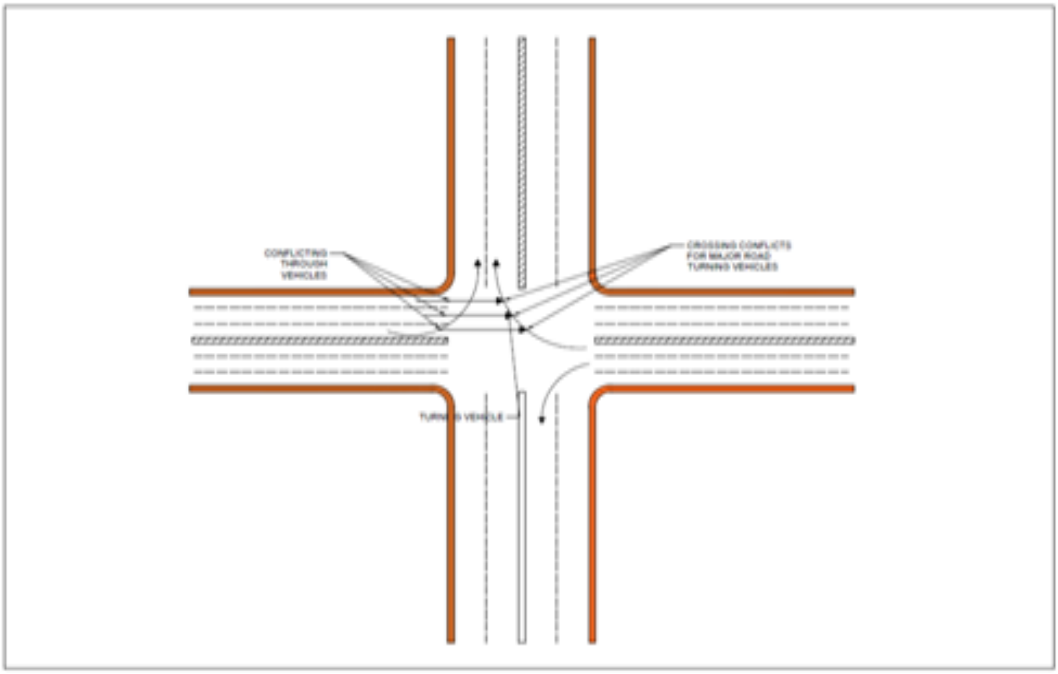


Fig 9: Uncontrolled intersection at the study area

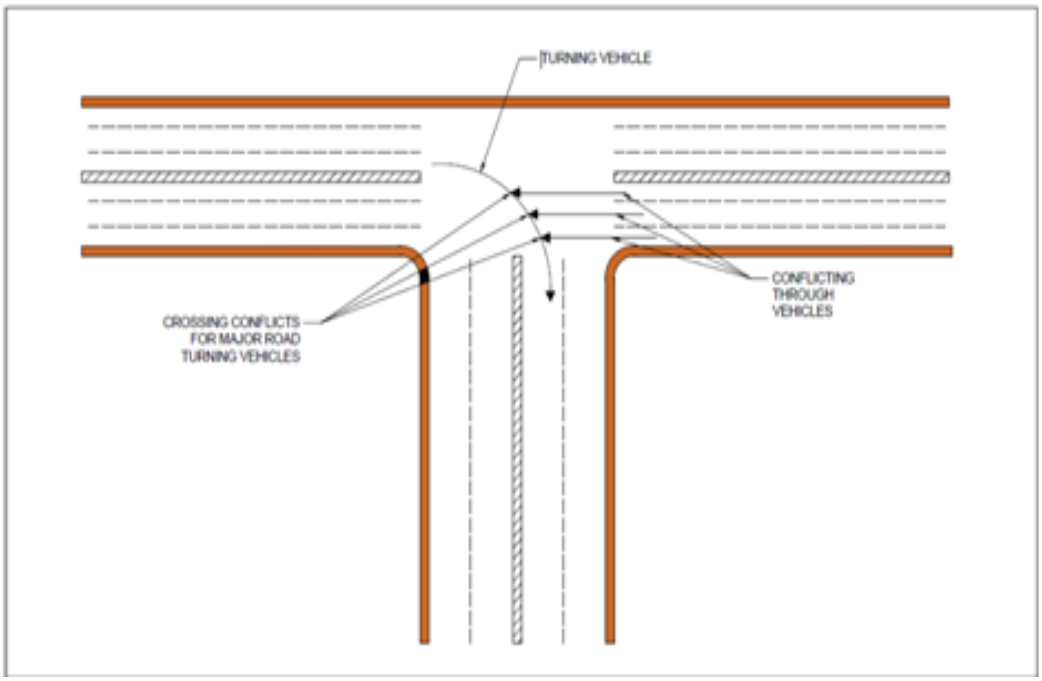


Fig 10: Uncontrolled intersection towards hebbal direction

CONCLUSIONS

Observations from final analytical results are given below:

- The total classified traffic volume from baglur towards hebbal on weekdays (Mon and Thursday) 21358 and 19583 volume/hr and weekend (sat)-20724.Similarly from hebbal to baglur on weekdays (Mon and Thursday) are 19641and 19055 whereas in the weekend (sat)-21688 respectively.

- From the Road Inventory which was carried out in the study area represents or clarifies that some of the roads in intersection meet the IRC standards and other roads present in the junction meet the IRC standards. So Some roads which are present in the intersections must be improved.

From the regression analysis it has been observed that, speed of the vehicle increases when volume of the vehicles decreases. From the observation which are done in the field and during the analysis, conclusion States that, the PCU values which were calculated on different days of the week does not fulfil the needs of providing enough road width for calculated volume count. The speed of the vehicles reduces in the intersection due to more movement of vehicles. From the volume data collected during Peak and Nonpeak hour, volume of

peak hour is more compared to non-Peak hour. Density of the vehicles were calculated to find the density in each direction of the road,

- 85th Percentile of spot speed study is found to be
  1. From hebbal to baglur =24.84 kmph
  2. Baglur to hebbal =21.24 kmph

- From Hebbal to Baglur
  Time mean speed= 20.55 kmph
  Space mean speed= 21.46 kmph

- From Baglur to hebbal
  Time mean speed= 16.73 kmph
  Space mean speed= 17.83 kmph

- From the regression analysis it has been observed that, speed of the vehicle increases when volume of the vehicles decreases.

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