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Analysis of Junction Under Mixed Traffic Condition in Bangalore City

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CHAPTER - 1

INTRODUCTION

Signalized intersections are among the most complex location in urban network As the operational quality of urban road system gradually deteriorates duo to increases in traffic volume and a higher level of service is required ,a well-planned and efficient improved scheme is necessary to assure a satisfactory condition of road transportation at all time .The evaluation of the current status and performance of road intersection is one of the important task in the management and improvement of urban traffic system. There is a need to understand that the congestion and delays that exist on our streets and roadways can be better managed with a thorough understanding of effective traffic signal timing and optimization. Well-developed, designed, implemented, maintained, and operated traffic signal control projects are essential to this process. Engineering tools are available to design, optimize, analyze, and simulate traffic flow.
The conflicts arising from movements of traffic in different directions is solved by time sharing of the principle. The advantages of traffic signal include an orderly movement of traffic, an increased capacity of the intersection and require only simple geometric design. However the disadvantages of the signalized intersection are it affects larger stopped delays, and the design requires complex considerations. Although the overall delay may be lesser than a rotary for a high volume, a user is more concerned about the topped delay.

1.1 Background

Bangalore is the capital of the Indian State of Karnataka. Bangalore is nicknamed the Garden City for its gardens and parks. Located on the Deccan Plateau in the south-eastern part of Karnataka, Bangalore is India's third most populous city and fifth-most populous urban agglomeration. Bangalore is well known as a hub for India's information technology sector. It is among the top 10 preferred entrepreneurial locations in the world.
A succession of South Indian dynasties ruled the region of Bangalore until in 1537 AD Kempegowda a feudatory ruler under the Vijayanagara Empire—established a mud fort considered to be the foundation of modern Bangalore. Following transitory occupation by Maratha and Mughal, the city remained under the Mysore kingdom. Bangalore continued to be a cantonment of the British and a major city of the Princely State of Mysore which existed as a nominally sovereign entity of the British Raj. Following the independence of India in 1947, Bangalore became the capital of Mysore state, and later Karnataka. .Today

as a large city and growing metropolis, Bangalore is home to many well-recognized colleges and telecommunications, and defence organisations are located in the city. Bangalore is known as the Silicon Valley of India because of its position as the nation's leading IT exporter. A demographically diverse city, Bangalore is a major economic and cultural hub and the second fastest growing major metropolis in India.

1.2 Project road

The Project Road shall consist of two different packages in the Bangalore city connecting the major areas such as towards kanakapura main road AND towards banashankari etc., Project road runs through urban areas and has a mix of fast and slow moving traffic. Project road has Single lane, Intermediate lane, two lane, four lane divided & undivided carriageway width without shoulders on different packages. Following are the list of roads;

1. **BRS convention hall junction**
2. **Raghuvanahalli signal junction**
3. **A2B junction**
4. **Konankunte cross junction**
5. **Yelachenahalli junction**
6. **J.p nagar signal junction**

1.3 Purpose of Traffic Signals

Traffic signals are used to assign vehicular and pedestrian right-of-way. They are used to promote the orderly movement of vehicular and pedestrian traffic and to prevent excessive delay to traffic.

Leading transportation professionals have long recognized the value of designing signal timing to meet specific operational objectives, and the value of monitoring performance to meet changing travel demands that can affect efficiency. Appropriately designed, operated, and maintained traffic signals can:

- provide for the smooth flow of traffic along streets and highways at defined speeds, thereby reducing congestion;
- effectively manage the traffic-handling capacity of intersections to improve mobility through the use of appropriate layouts and control measures and regular reviews and updates to the operational parameters; and
- reduce vehicle stops and delays, thereby:
- lessening the negative impacts to air quality;
- reducing fuel consumption
- Minimizing delay to vehicles and pedestrians;
- Reducing crash-producing conflicts
- Maximizing capacity for each intersection approach.

1.4 Traffic survey

The following traffic surveys were carried out to collect requisite information:

Classified traffic volume count surveys

□ Intersection Turning Movement Survey

1.1 Recommended PCU Factors for various types of Vehicles on Urban Road (IRC:106 – 1990)			
Sl. No.	**Vehicle Type**	**Equivalent PCU Factors**	
		Percentage of Vehicles in Traffic Stream	
	Fast Vehicles	**5%**	**10% and above**
1	Two Wheeler	0.50	0.75
2	Auto Rickshaw	1.00	1.00
3	car/ Jeep/ Van	1.20	2.00
5	Truck or Bus	2.20	3.70
6	Agricultural Tractor Trailer	4.00	5.00

CHAPTER – 2
LITERATURE REVIEW

2.1 Synchronization of traffic signals

During the past decade major cities have undergone haphazard growth of Industrialization of country. Consequently the urban population has travel greater distances within minimum possible time. To manage travel demand the intersection should be give least resistance to traffic flow so that the travel time can be minimized. The present requirement of metropolitan cities is to absorb the growing traffic demand but within the same physical dimension at the intersection. In this paper an attempt has been made to study the various intersections so as to minimize the delays at these intersections and consequently improve the level of service. Traffic signal can be synchronized so that a vehicle starting at one end of the street and travelling at preassigned speed can go to other end without stopping for red light. H.S. Goliya & Nitin Kumar Jain"A Case Study –Eastern Ring Road, Indore"

2.2 System to Identify Turning Movement at Signalized Intersection

- Mark R.Virkler & Narla Raj Kumar

A system to identify all left turns, through movement, and right turns at s signalized intersection is described .The complete system requires detection of vehicle departures from the intersection .right turn detection ,and information on present phasing from the signal controller.The system isdemonstrated withvideotape data for one departure leg signalized intersection.

2.3 Performance Evaluation of Signalized Urban Intersections under Mixed Traffic Condition

-S.C. Wong

Quantitativeevaluation and ranking of the operational and safety performance of signalized intersections in urban areas under mixed traffic conditions. Mixed traffic condition refer to traffic situations in which

motor vehicles, bicycles, and pedestrians share a signalized intersection. Such mixed traffic is a physical phenomenon in many cities around the world in the population of urban areas are extremely large.

2.4 STUDY OF TRAFFIC FLOW CHARACTERISTICS AND REMEDIAL MEASURES TO OVERCOME.

Summary:· The methodology involves a Pilot survey, Selection of critical points, Data collection, Traffic volume study, and Pedestrian opinion survey.

The main objective of the study are:

- To measure traffic volumes and note other related traffic characteristics.
- To determine vehicle composition in the traffic stream.
- To investigate the geometric elements
- To investigate the problems faced by pedestrians while crossing.

A traffic volume study was conducted on all the days i.e from Sunday to Saturday continuously for 12 hours from 7.30 AM to 7.30 PM which was concluded to be the busiest hours through the Pilot survey. The pedestrian count was done for 4 hrs i.e 8.00 AM to 10.00 AM and 5 PM to 7 PM. A pedestrian opinion survey was conducted and for this, 20 people were interviewed.

The study conducted to analyze the traffic characteristics of Kengeri -Uttarahalli road indicated that the main cause of congestion was the higher traffic volume during peak hours. In addition to this, the pedestrian flow was found to skyrocket during peak hours leading to the obstruction of traffic flow. It was concluded that the present road catered to very heavy traffic and failed to produce the required level of service. The poor condition of the road added more weight to the traffic congestion issue.

REMEDIAL MEASURES: Some of the remedial measures suggested in this paper were widening the road, increasing the number of lanes, providing traffic signals at intersections and medians or separators between the opposite lanes, improving the footpath condition, and providing skywalks.

Keywords: Traffic characteristics, Traffic congestion, Traffic volume study, Pedestrian flow, Pedestrian opinion, Widening of road and Lanes

2.5. Study of Road Traffic Management: A Case Study at Katraj and Nal Stop Intersections In Pune City

Summary:

1:The study is based on the road resources and characteristics of the urban traffic found from the video recordings done at the junction for 8 days during the peak and non-peak hours. Based on the Vehicular Volume Dataand Turning Movement Survey observed at these intersections, the paper discusses the solution to the increasing congestion and its effect on the traffic.

2:A speed and delay survey at the intersection was also done by a moving car observer method. The average delay time required by vehicle at the junction is noted and the average speed of travel was also noted in the required formats.

3:From the data obtained, the PCU (Passenger Car Unit/ Passenger Car Equivalent) values are found according to Indian standards.

4:The graphs of hourly variation of traffic, traffic composition a

The TDM strategies that can be applied at the two intersections are:

1. Increasing the Intelligent Transport System by redesigning the signal system at the two intersections accommodate the increasing traffic.
2. Traffic claiming can be done at the Katraj intersection by providing a Y-flyover, whose one arm shall be for traffic coming from Pune and going to Katraj; and the other arm for traffic coming from Pune and going to Mumbai Bangalore Expressway Bypass. In addition to it the signal system at Katraj intersection also needs to be redesigned for the increasing traffic.

KEYWORDS: Non-Peak Hours, Peak Hours, Road Traffic Demand Management, Traffic Congestion, Turning Movement Survey, Vehicular Volume

2.6 Traffic Characteristics Evaluation and Traffic Management Measures: A Case study of Dharwad City

Summary: Heavy traffic volume and lower speed are the indicators of the need to improve the transport facilities and is an invaluable tool in the hands of a transport planner.

1: Traffic management measures normally involve traffic engineering improvements, regulation and control of the movement of a different category of vehicles on the road system to ensure safe and efficient movement of traffic.

2: The problem of delay, congestion and accidents can be decreased to some extent by controlling the traffic, imposing regulatory measures and enforcing proper management of road space so as The objective of this study is to obtain the traffic characteristics like spot speed, Speed and delay of the particular stretch road and the volume counts at the intersections of Dharwad city. The data is used to determine the level of service, amount of congestion and the measures that need to be taken in order to ease the situation.

- Spot study: The average speed of vehicles on Old PB road towards Belgaum was found to be 31 kmph, and speed average measured on Dandeli road is 32 kmph, and on Saudati, road is around 25 kmph. On all the roads, it is observed that speeds of two-wheelers and cars are high, in the range of 30-40kmph.

Whereas auto, buses and truck speed is in the range of 25-30 kmph.

- Speed and delay: The study reveals that on the major corridor, the delay was at junctions and due to bus stops, and in the CBD area, the delay was due to congestion, pedestrian movements and bus stands.

- Volume count: A traffic volume count indirectly indicates the capacity utilization. to make the most economical use of the roads.

3: Due to the movement of a heavy volume of traffic, many of the narrow roads get choked thereby needing the enforcement of traffic management measures such as one-way streets, restriction on commercial

vehicles within the city, restriction on turning movements and closing side streets.

4: Heavy commercial vehicles occupy considerable road space and cause serious impediments to traffic.

5: Closing the busy roads for commercial vehicles will preserve the utility of the roads, improve the speed, safety and comfort of another road user.

6: Traffic management measures proposed are based on the findings of the study carried out in Dharwad city.

Keywords: Dharwad, Traffic management, Speed and delay, Spot speed, Vehicle growth, Length growth

CHAPTER - 3

METHODOLOGY FOR TRAFFIC SURVEYS

3.1 Classified Traffic Volume Count

Hourly traffic counts were conducted for one day (16 hours) simultaneously in both directions at each survey location to obtain data on the magnitude of traffic flow, hourly variation and the traffic composition. The survey was carried out by manual vehicle counting and classifying the vehicles passing the survey station in both directions, in 15 minutes intervals. The counts were made separately for motorised and non-motorised traffic as per the vehicle classification system shown in Table 2.1 below

3.2 Intersection Turning Movement Survey

The surveys were conducted for one day (16 hours) to obtain classified turning movement at the identified junctions. The data was collected by deploying enumerators to record data for each hour within fifteen minutes intervals. All the surveys were conducted through trained enumerators and were supervised byt traffic engineers. The surveys were conducted for one day (16 hours) to obtain classified turning movement at the identified junctions. The data was collected by deploying enumerators to record data for each hour within fifteen minutes intervals. All the surveys were conducted through trained enumerators and were supervised by traffic engineers.

3.3 Webster method

In this method, the optimum signal cycle C_o corresponding to least delay to the vehicles at the signalized intersection has been worked out. Filed work consists of finding:

- The saturation flow S per unit time on each approach of the water section ;
- The normal flow q on each approach during the design hour;

Based on the higher value of normal flow ,the ratio $y_1 = q_1/s_1$ and $y_2 = q_2/s_2$ are determined on approach roads 1 and 2.In the mixed traffic ,it is necessary to convert all the normal flow and saturation flow vales in terms of suitable PCU values which should determine separately.

The saturation flow is to be obtained from careful field studies by noting the number of vehicles in stream of compact flow during the green phase and the corresponding time intervals precisely. In the absence of the data the approximate values of saturation flow is estimated pcu per meter width of the approach. The normal flow of the traffic is also determined on the approach roads from the field studies for design.
The optimum signal cycle is given by:

$$Co = \frac{1.5\mathbf{L} + \mathbf{5}}{\mathbf{1} - \mathbf{Y}}$$

$Y = y_1 + y_2$

$$y = \frac{\mathbf{q}}{\mathbf{s}}$$

$G_1 = \frac{Y_1}{Y}\frac{Y_1}{Y}$ $(C_o - L)$ and $G2 = \frac{Y_2}{Y}\frac{Y_2}{Y}$ $(C_o - L)$
Where; L= total lost time per cycle, sec. = 2n+R

n = number of phase R= all red time
s = saturation flow pcu's/hr. q = normal flow pcu's/hr.

CHAPTER – 4

DATE COLLECTION AND FIELD INVESTIGATION

4.1 Site Visit

The traffic engineer should conduct a site visit to gather current traffic information not readily available from other sources. Data collection during the site visit normally includes the followings.

4.1.1 Road geometrics

- Curves and grades;
- Number of lanes, lane usage, and presence and type of medians;
- Lane,median,and shoulder widths;

4.1.2 Traffic control

- Traffic signals and phasing;
- Traffic signs;
- Regulatory pavement markings;
- Marked and unmarked crosswalk location;

4.1.3 Traffic

- Presence and needs of children, elderly persons, disabled;
- Sidewalk, bicycle lanes and multi use paths;
- transit stop location and amenities, transit schedules;
- travel times;

4.1.4 Land use

- Driveways for major vehicle generators ;
- Adjacent land use, density, and occupancy;

4.1.5 Others

- Pavement condition
- Presence and type of on street parking and parking regulation;
- Street lighting;
- Road functional classification

4.2 Existing traffic data

Typical traffic data requests include 24 hour volume counts and peak hour turning movement counts. The highest traffic volumes are usually during the weak day morning and evening travel periods. However, the some areas, such as near major shopping centers and recreational areas, the highest traffic volumes may also change with time due to development. The time and duration of peak periods should be verified by careful review of 24 hour volume counts.

Existing traffic data used for forecasting should generally be no more than one year old. Existing traffic

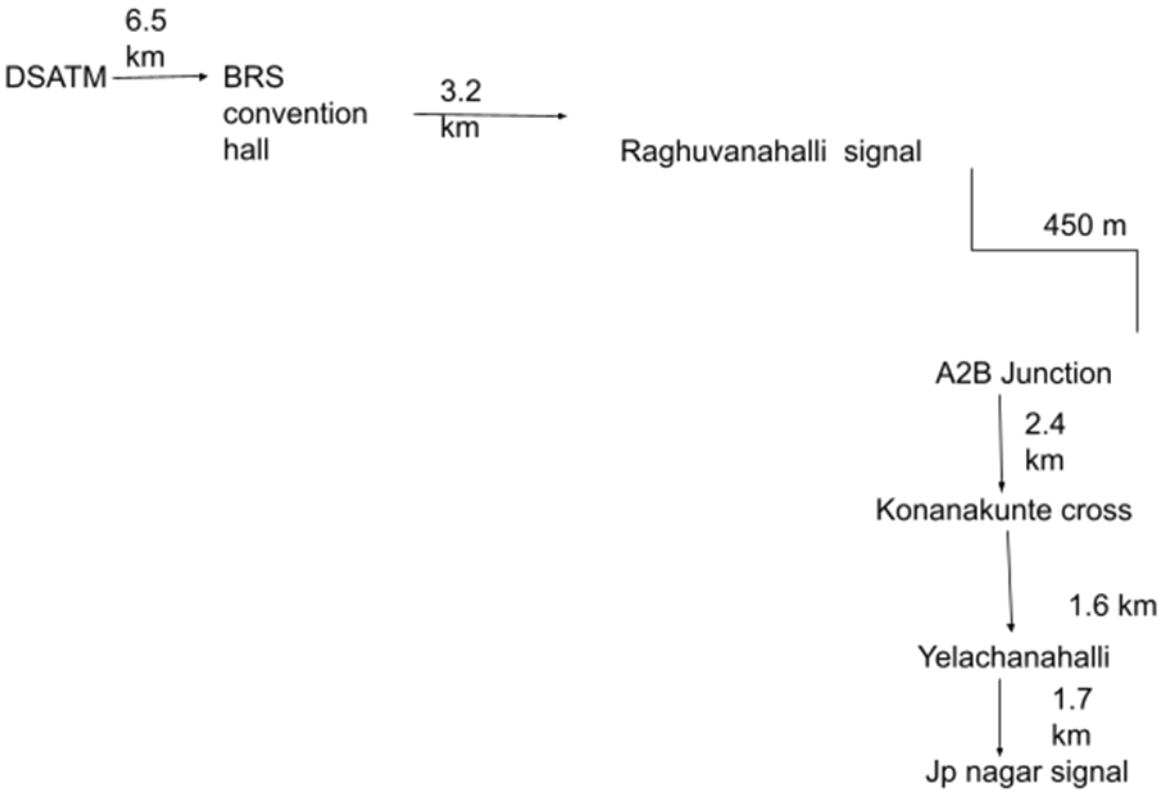
data used for forecasting should generally be no more than one year old. Existing traffic data for forecasting frequently includes the following:

- classification machine counts ;
- turning movement counts for 8 t0 10 hour durations, for proposed new signals;
- one day directional volumes, speed; and in some location, vehicle classification machine counts;

4.3 Daily Traffic Volumes

Traffic volume data is commonly reported as a daily value. Daily volumes are typically used for highway planning and the design of pavement structures. The following four daily volumes are widely used;

- **Average Annual Daily Traffic (AADT)**is defined as the average of measured 24-hour traffic volumes at a given location over a full, 365-day year. This means the total of vehicles passing the site in a year divided by 365.



4.1 Line Diagram of JP nagar to Dsatm Bangalore

- **Average Daily Traffic (ADT)** is defined as the average of 24-hour traffic volumes for a given location for some period of time less than a year. while AADT is measured over a full year, an ADT may be measured for six months, a season, a month, and a week or as little as two days. Therefore, an ADT is valid for the period for which it was measured.

CHAPTER-5

ANALYSIS

Table 4.2 Classified turning traffic count at Raghuvanahalli junction

CLASSIFIED TRAFFIC VOLUME COUNT SURVEY									
Direction Towards :		KK cross							
Hour :		1				road width =		7.5 m	
Date :		07.04.2023							
pcu factor	0.5	1.00	1.2	2.2	2				
Time	Two Wheeler	Car/Van/ Ta xi	Three Wheeler/ Auto Rickshaw	Bus/tru c k	LCV	sum	pcu	total volume	pcu/hour
9.00 - 9.15	400	90	35	90	7	622	544		
9.15 - 9.30	354	80	50	17	3	504	360.4		
9.30 - 9.45	325	98	35	20	6	484	358.5		
9.45 - 10.00	315	60	35	21	5	436	315.7	2046	1578.6
10.00 - 10.15	375	85	34	20	10	524	377.3		
10.15 - 10.30	350	70	20	19	4	463	318.8		
10.30 - 10.45	330	30	27	24	6	417	292.2		
10.45 - 11.00	315	25	30	15	3	388	257.5	1792	1245.8
11.00 - 11.15	80	60	25	15	5	185	173		
11.15 - 11.30	65	45	23	12	6	151	143.5		
11.30 - 11.45	78	37	26	20	3	164	157.2		
11.45 - 12.00	45	24	15	13	8	105	109.1	605	582.8
Afternoon									
2.00 - 2.15	50	45	28	14	2	139	138.4		
2.15 - 2.30	20	20	16	12	4	72	83.6		
2.30 - 2.45	33	30	21	10	6	100	105.7		
2.45 - 3.00	27	15	20	13	3	78	87.1	389	414.8
3.00 - 3.15	75	30	20	10	4	139	121.5		

3.15 - 3.30	37	26	25	17	3	108	117.9		
3.30 - 3.45	39	20	10	20	3	92	101.5		
3.45 - 4.00	24	15	17	17	5	78	94.8	417	435.7
Evening									
4.00 -4.15	85	48	35	20	15	203	206.5		

4.15 - 4.30	85	45	35	23	4	192	188.1		
4.30 - 4.45	100	43	25	30	6	204	201		
4.45 - 5.00	100	30	35	35	4	204	207	803	802.6
5.00 - 5.15	130	80	35	30	1	276	255		
5.15 - 5.30	138	60	40	23	4	265	235.6		
5.30 - 5.45	150	55	38	58	3	304	309.2		
5.45 - 6.00	152	75	60	30	5	322	299	1167	1098.8
total=	4277	1341	815	648	138	7219	6159.1		

Table 4.3 Classified traffic count at raghuvanahalli junction (from thurahlli)

Direction Towards :		Thurahal i							
Hour :		1				road width		7..5 m	
Date :		07.04.2023							
pcu factor	0.5	1.00	1.2	2.2	2				
Time	Two Wheeler	Car/Van/ Taxi	Three Wheeler/	Bus/truck	LCV	sum	pcu	total volume	pcu/hour
9.00 - 9.15	400	150	30	50	6	636	508		
9.15 - 9.30	526	65	21	29	5	646	427		
9.30 - 9.45	123	52	32	20	8	235	211.9		
9.45 - 10.00	389	98	35	27	6	555	405.9	2072	1552.8
10.00 - 10.15	375	80	30	20	4	509	355.5		
10.15 - 10.30	365	95	34	27	3	524	383.7		
10.30 -10.45	352	98	30	30	6	516	388		
10.45 - 11.00	200	60	25	15	2	302	227	1851	1354.2

11.00 - 11.15	79	59	20	24	3	185	181.3		
11.15 - 11.30	60	45	23	15	5	148	145.6		
11.30 - 11.45	78	37	30	18	5	168	161.6		
11.45 - 12.00	25	20	26	20	4	95	115.7	596	604.2
afternoon									
2.00 - 2.15	50	39	25	14	2	130	128.8		
2.15 - 2.30	36	25	16	2	5	84	76.6		
2.30 - 2.45	59	20	21	10	3	113	102.7		
2.45 - 3.00	15	15	20	13	4	67	83.1	394	391.2
3.00 - 3.15	56	30	30	54	5	175	222.8		
3.15 - 3.30	75	19	35	20	6	155	154.5		
3.30 - 3.45	60	23	15	12	5	115	107.4		
3.45 - 4.00	65	20	23	10	2	120	106.1	565	590.8
evening									
4.00 -4.15	85	48	35	20	15	203	206.5		
4.15 - 4.30	85	45	35	23	4	192	188.1		
4.30 - 4.45	100	43	25	30	5	203	199		
4.45 - 5.00	100	29	35	35	4	203	206	801	799.6
5.00 -5.15	120	30	30	35	3	218	209		
5.15 - 5.30	70	25	20	25	1	141	141		
5.30 - 5.45	80	40	25	20	1	166	156		
5.45 - 6.00	85	30	24	15	5	159	144.3	684	650.3
total=	4113	1340	750	633	127	6963	5943.1		

Table-4.4 Existing signal timing at raghuvanahalli junction

Junction name:- raghuvanahalli junction				
		Time: 01:00pm		
From	To	Signal timings(sec)		
		Green	Red	Amber
kk cross	silk institute	55	30	3
	thuralli	15	70	
silk institute	kk cross	35	54	
	thuralli	35	54	

thuralli	kk cross	74	18	
	silk institute	74	18	

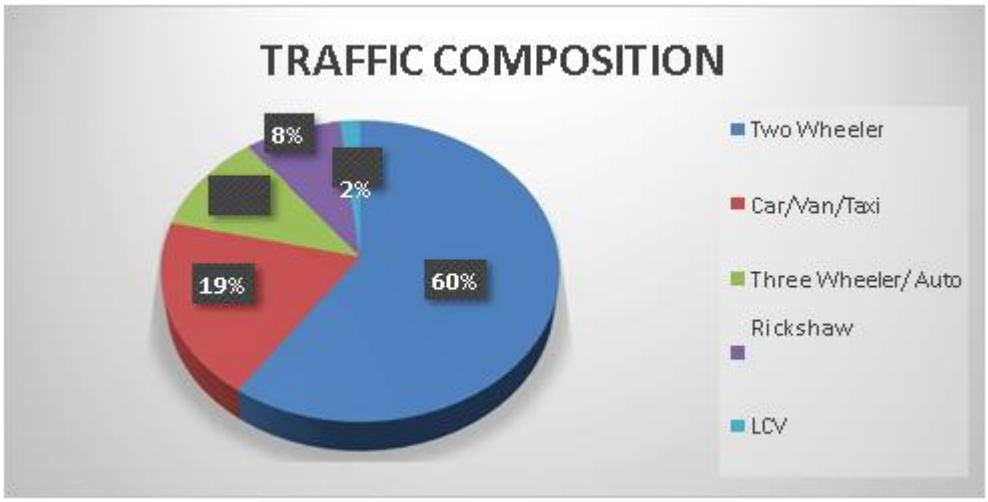
Table 4.5 Peak hour traffic at raghuvanahalli junction

From	**To**	**Morning Peak**		**Evening Peak**	
		9:00 to 10:00		**05:00 to 06:00**	
		Volume	**PCU's**	**Volume**	**PCU's**
Thurahalli	Kk Cross	2072	1553	684	650.3
	Silk Institute				
Kk Cross	Silk Institute	2046	1579	1167	1099
	Thurahalli				
Silk Institute	Kk Cross	2171	1569	942	824
	Turahalli				

Table 4.2 Classified traffic count at raghuvanahalli junction (towards silk intistute)

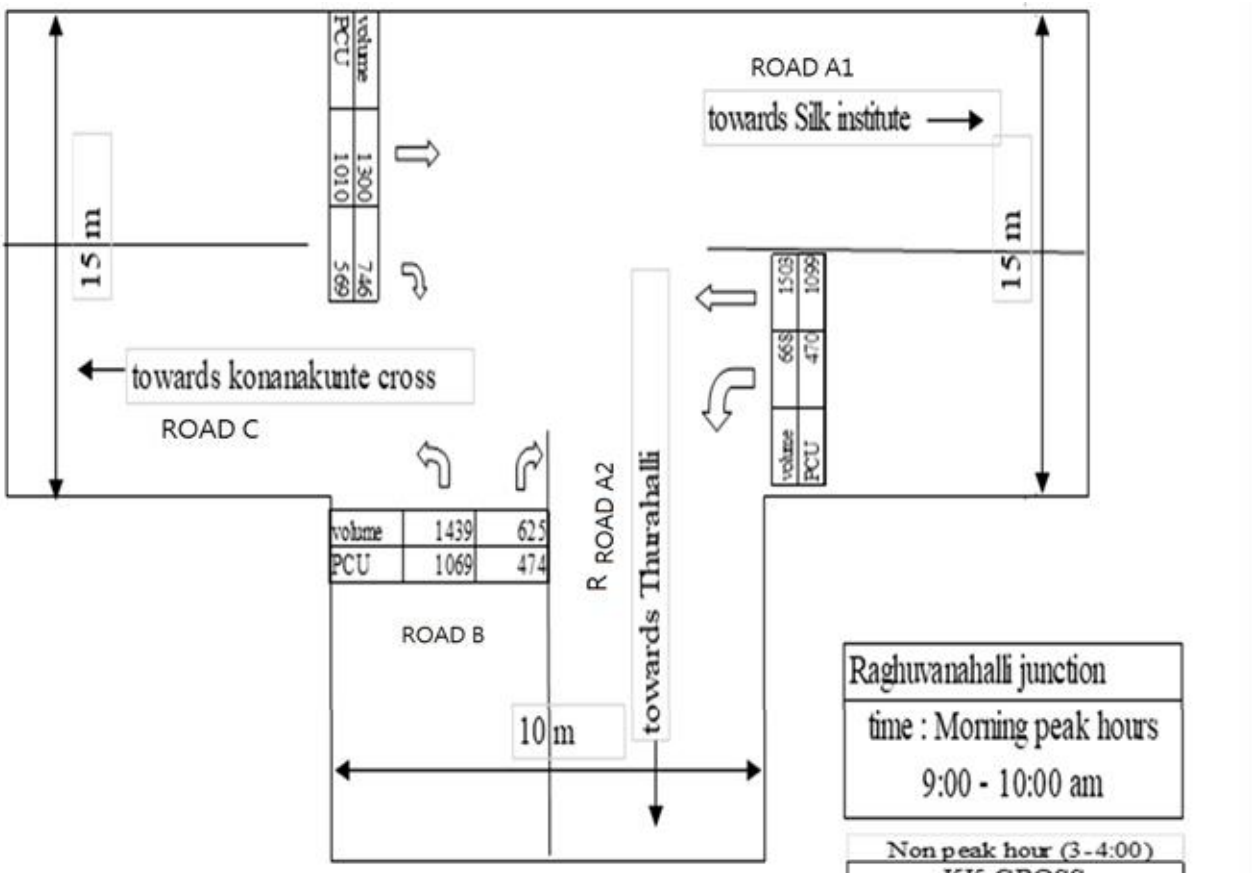
Direction Towards :		Silk Institute							
Hour :		1				road width		7..5 m	
Date :		07.04.2023							
pcu factor	0.5	1.00	1.2	2.2	2				
Time	Two Wheeler	Car/Van/ T a xi	Three Wheeler/	Bus/truck	LCV	sum	pcu	total volume	pcu/hour
9.00 - 9.15	750	100	40	38	3	828	456		
9.15 - 9.30	600	185	20	32	5	740	385		
9.30 - 9.45	450	180	32	24	4	688	349.8		
9.45 - 10.00	460	90	35	29	6	615	378	2471	1768.8
10.00 10.15	280	120	30	24	4	514	358		
10.15 - 10.30	430	112	39	30	3	579	356.2		
10.30 -10.45	450	99	40	32	6	591	364		
10.45 - 11.00	278	77	38	18	2	352	252	1936	1450.2
11.00 - 11.15	90	78	42	28	3	285	181.3		
11.15 - 11.30	70	76	37	18	5	248	145.6		

11.30 - 11.45	89	45	29	20	5	168	161.6		
11.45 - 12.00	34	25	24	20	4	93	113.3	674	678.8
afternoon									
2.00 - 2.15	65	39	25	14	2	130	128.8		
2.15 - 2.30	32	15	16	2	5	78	73.6		
2.30 - 2.45	22	210	21	10	3	74	83.2		
2.45 - 3.00	18	135	20	13	4	67	83.1	449	368.7
3.00 - 3.15	67	130	30	15	5	165	151.5		
3.15 - 3.30	88	119	35	7	6	142	125.9		
3.30 - 3.45	98	113	15	12	5	105	97.4		
3.45 - 4.00	78	120	23	10	2	120	106.1	632	580.9
evening									
4.00 -4.15	89	248	35	20	15	203	206.5		
4.15 - 4.30	106	145	35	23	4	192	188.1		
4.30 - 4.45	146	243	25	30	6	204	201		
4.45 - 5.00	178	430	35	35	4	204	207	803	802.6
5.00 -5.15	145	230	30	15	3	198	165		
5.15 - 5.30	240	225	20	25	1	141	141		
5.30 - 5.45	280	140	25	20	1	166	156		
5.45 - 6.00	285	130	27	15	1	158	139.9	663	601.9
total=	5489	2287	760	547	117	6948	5754.9		



4.1 TotalCycle Time Calculation based on Webster's method

Width of Road-1 = 15m or total 4 lanes, with 2 lanes in each direction. Width of Road-2 = 10m or total 2 lanes, with one lane in each direction.



Raghuvanahalli junction
time : Morning peak hours
9:00 - 10:00 am

Non peak hour (3-4:00)

KK CROSS		
volume	314	109
PCU	329	114
THURAHALLI		
volume	410	155
PCU	437	154
SILK INSTITUTE		
volume	350	182
PCU	332	149

Table 4.2 Classified turning traffic count at kk cross junction

CLASSIFIED TRAFFIC VOLUME COUNT SURVEY									
Direction Towards :		jp nagar signal							
Hour :		1				road width =		7.5 m	
Date :		07.04.2023							
pcu factor	0.5	1.00	1.2	2.2	2				
Time	Two Wheeler	Car/Van/ Ta xi	Three Wheeler/ Auto Rickshaw	Bus/tru c k	LCV	sum	pcu	total volume	pcu/hour
9.00 - 9.15	500	100	45	100	9	722	644		
9.15 - 9.30	454	90	60	27	6	604	460.4		
9.30 - 9.45	425	108	45	30	8	584	458.5		
9.45 - 10.00	315	70	35	31	7	536	415.7	3046	2578.6
10.00 - 10.15	475	95	44	30	13	624	477.3		
10.15 - 10.30	450	80	30	29	8	563	518.8		
10.30 - 10.45	430	40	37	34	9	517	392.2		
10.45 - 11.00	415	35	40	25	6	488	357.5	2792	2245.8
11.00 - 11.15	90	70	35	25	8	285	273		
11.15 - 11.30	75	55	33	22	9	251	243.5		
11.30 - 11.45	88	47	36	30	6	264	257.2		
11.45 - 12.00	55	34	25	23	10	205	209.1	705	682.8
Afternoon									
2.00 - 2.15	60	55	38	24	4	239	238.4		
2.15 - 2.30	30	30	26	22	8	82	93.6		
2.30 - 2.45	43	40	31	20	9	100	205.7		
2.45 - 3.00	37	25	30	23	6	88	97.1	489	514.8

3.00 - 3.15	85	40	20	20	7	239	221.5		
3.15 - 3.30	47	36	35	37	6	208	217.9		
3.30 - 3.45	49	90	20	30	6	112	101.5		
3.45 - 4.00	34	25	47	27	8	88	94.8	517	535.7
Evening									
4.00 -4.15	95	58	45	30	18	303	306.5		
4.15 - 4.30	95	65	45	33	7	292	288.1		
4.30 - 4.45	200	53	35	40	9	304	301		
4.45 - 5.00	100	40	45	45	7	304	307	903	902.6
5.00 - 5.15	230	90	45	40	4	376	355		
5.15 - 5.30	238	70	50	33	8	365	435.6		
5.30 - 5.45	250	65	48	68	6	404	409.2		
5.45 - 6.00	252	85	70	40	8	422	399	2167	2098.8
total=	5277	2341	915	748	238	8219	7159.1		

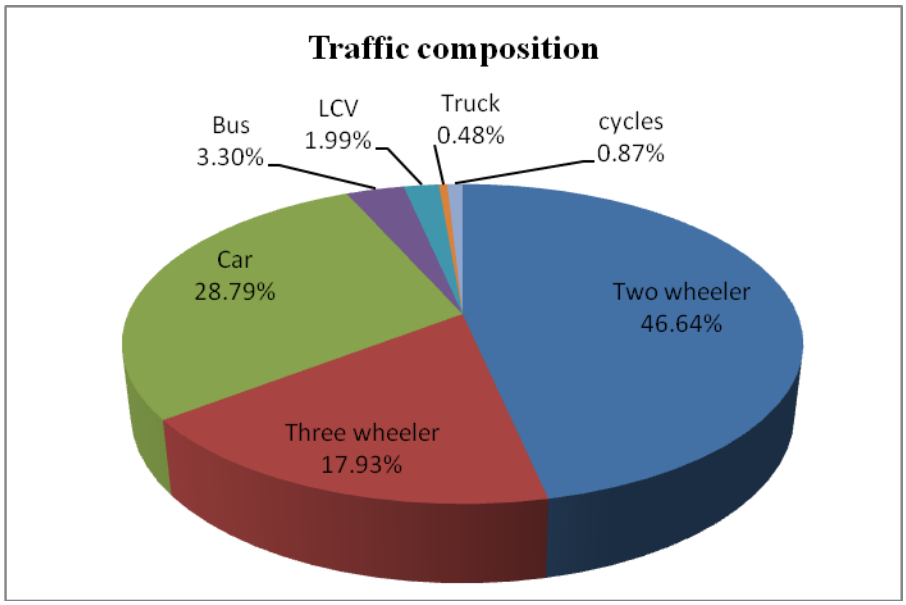


Table 4.2 Classified traffic count at kk cross junction (towards silk intistute)

Direction Towards :		Silk Institute							
Hour :		1				road width		7..5 m	
Date :		07.04.2023							
pcu factor	0.5	1.00	1.2	2.2	2				
Time	Two Wheeler	Car/Van/ T a xi	Three Wheeler/	Bus/truck	LCV	sum	pcu	total volume	pcu/hour
9.00 - 9.15	750	100	40	38	3	828	456		

9.15 - 9.30	600	185	20	32	5	740	385		
9.30 - 9.45	450	180	32	24	4	688	349.8		
9.45 - 10.00	460	90	35	29	6	615	378	2471	1768.8
10.00 10.15	280	120	30	24	4	514	358		
10.15 - 10.30	430	112	39	30	3	579	356.2		
10.30 -10.45	450	99	40	32	6	591	364		
10.45 - 11.00	278	77	38	18	2	352	252	1936	1450.2
11.00 - 11.15	90	78	42	28	3	285	181.3		
11.15 - 11.30	70	76	37	18	5	248	145.6		
11.30 - 11.45	89	45	29	20	5	168	161.6		
11.45 - 12.00	34	25	24	20	4	93	113.3	674	678.8

afternoon									
2.00 - 2.15	65	39	25	14	2	130	128.8		
2.15 - 2.30	32	15	16	2	5	78	73.6		
2.30 - 2.45	22	210	21	10	3	74	83.2		
2.45 - 3.00	18	135	20	13	4	67	83.1	449	368.7
3.00 - 3.15	67	130	30	15	5	165	151.5		
3.15 - 3.30	88	119	35	7	6	142	125.9		
3.30 - 3.45	98	113	15	12	5	105	97.4		
3.45 - 4.00	78	120	23	10	2	120	106.1	632	580.9
evening									
4.00 -4.15	89	248	35	20	15	203	206.5		
4.15 - 4.30	106	145	35	23	4	192	188.1		
4.30 - 4.45	146	243	25	30	6	204	201		
4.45 - 5.00	178	430	35	35	4	204	207	803	802.6
5.00 -5.15	145	230	30	15	3	198	165		
5.15 - 5.30	240	225	20	25	1	141	141		
5.30 - 5.45	280	140	25	20	1	166	156		
5.45 - 6.00	285	130	27	15	1	158	139.9	663	601.9
total=	5489	2287	760	547	117	6948	5754.9		

Table 4.2 Classified traffic count at jp nagar junction(towards banashankari)

Direction Towards :		Silk Institute							
Hour :		1				road width		7..5 m	
Date :		07.04.2023							
pcu factor	0.5	1.00	1.2	2.2	2				
Time	Two Wheeler	Car/Van/ T a xi	Three Wheeler/	Bus/truck	LCV	sum	pcu	total volume	pcu/hour
9.00 - 9.15	568	230	58	47	9	850	560		
9.15 - 9.30	549	95	48	44	11	740	490		
9.30 - 9.45	463	93	42	32	8	580	450.8		
9.45 - 10.00	430	110	47	35	10	650	480	4171	4568.8
10.00 - 10.15	489	93	45	31	9	610	460		
10.15 - 10.30	435	95	44	38	7	580	460.2		
10.30 -10.45	456	86	40	44	10	560	380		
10.45 - 11.00	376	74	38	29	9	490	380	3836	4330.2
11.00 - 11.15	90	69	31	36	7	285	288.3		
11.15 - 11.30	75	56	31	25	10	240	250.6		
11.30 - 11.45	94	50	49	29	10	270	270.6		
11.45 - 12.00	40	33	35	32	14	130	215.3	794	801.8
afternoon									
2.00 - 2.15	65	55	39	25	6	240	230.8		
2.15 - 2.30	44	40	25	7	9	98	90.6		
2.30 - 2.45	37	30	30	29	9	89	100.2		
2.45 - 3.00	27	27	35	24	10	80	99.1	649	568.7
3.00 - 3.15	98	44	43	25	9	270	260.5		
3.15 - 3.30	85	30	49	9	10	255	250.9		
3.30 - 3.45	73	27	29	23	9	220	109.4		
3.45 - 4.00	77	43	36	27	6	233	209.1	650	680.9

evening

4.00 -4.15	94	63	49	36	25	320	375		
4.15 - 4.30	97	57	50	37	11	300	289.1		
4.30 - 4.45	230	53	48	46	14	310	301		
4.45 - 5.00	200	43	45	48	10	315	310	915	1002.6
5.00 -5.15	250	40	40	27	9	300	266		
5.15 - 5.30	85	35	33	33	4	290	260		
5.30 - 5.45	95	30	37	30	6	240	256		
5.45 - 6.00	96	47	43	27	5	250	239.9	863	901.9
total=	5237	2287	860	647	217	8050	7754.9		

Figure 5.1 Vehicle wise hourly traffic variation traffic at kk cross junction.

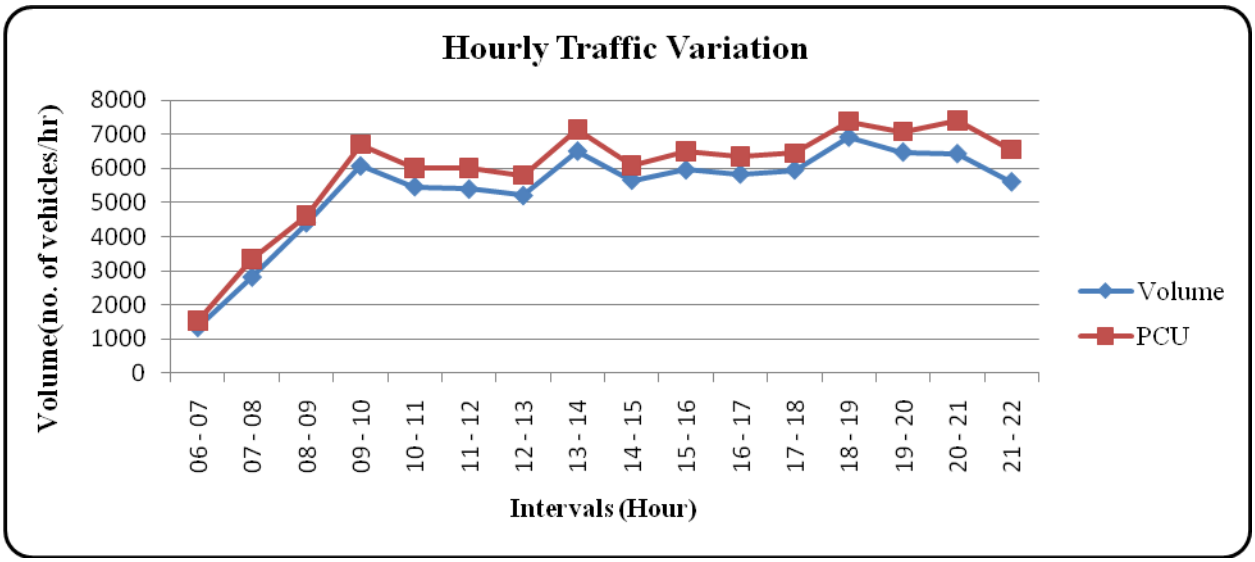


Table 5.2 Peak hour traffic at kk cross junction

From	To	Morning Peak		Evening Peak	
		09:00 to 10:00		20:00 to 21:00	
		Volume	PCU's	Volume	PCU's
konankunte	towards Anjanapura	994	997.45	1283	1264.9
	towards banashankri	570	694.85	725	899.9
konanakunt e	towards dsatm	1975	2119.45	1882	2007.1

Table 4.2 Classified turning traffic count at jp nagar junction

CLASSIFIED TRAFFIC VOLUME COUNT SURVEY									
Direction Towards :		banashankari							
Hour :		1				road width =		7.5 m	
Date :		07.04.2023							
pcu factor	0.5	1.00	1.2	2.2	2				
Time	Two Wheeler	Car/Van/ Ta xi	Three Wheeler/ Auto Rickshaw	Bus/tru c k	LCV	sum	pcu	total volume	pcu/hour
9.00 - 9.15	500	100	45	100	9	722	644		
9.15 - 9.30	454	90	60	27	6	604	460.4		
9.30 - 9.45	425	108	45	30	8	584	458.5		
9.45 - 10.00	315	70	35	31	7	536	415.7	3046	2578.6
10.00 - 10.15	475	95	44	30	13	624	477.3		
10.15 - 10.30	450	80	30	29	8	563	518.8		
10.30 - 10.45	430	40	37	34	9	517	392.2		
10.45 - 11.00	415	35	40	25	6	488	357.5	2792	2245.8
11.00 - 11.15	90	70	35	25	8	285	273		
11.15 - 11.30	75	55	33	22	9	251	243.5		
11.30 - 11.45	88	47	36	30	6	264	257.2		
11.45 - 12.00	55	34	25	23	10	205	209.1	705	682.8
Afternoon									
2.00 - 2.15	60	55	38	24	4	239	238.4		
2.15 - 2.30	30	30	26	22	8	82	93.6		
2.30 - 2.45	43	40	31	20	9	100	205.7		
2.45 - 3.00	37	25	30	23	6	88	97.1	489	514.8
3.00 - 3.15	85	40	20	20	7	239	221.5		
3.15 - 3.30	47	36	35	37	6	208	217.9		

3.30 - 3.45	49	90	20	30	6	112	101.5		
3.45 - 4.00	34	25	47	27	8	88	94.8	517	535.7
Evening									
4.00 -4.15	95	58	45	30	18	303	306.5		
4.15 - 4.30	95	65	45	33	7	292	288.1		
4.30 - 4.45	200	53	35	40	9	304	301		
4.45 - 5.00	100	40	45	45	7	304	307	903	902.6
5.00 - 5.15	230	90	45	40	4	376	355		
5.15 - 5.30	238	70	50	33	8	365	435.6		
5.30 - 5.45	250	65	48	68	6	404	409.2		
5.45 - 6.00	252	85	70	40	8	422	399	2167	2098.8
total=	5277	2341	915	748	238	8219	7159.1		

Direction Towards :		Silk Institute							
Hour :		1				road width		7..5 m	
Date :		07.04.2023							
pcu factor	0.5	1.00	1.2	2.2	2				
Time	Two Wheeler	Car/Van/ T a xi	Three Wheeler/	Bus/truck	LCV	Sum	pcu	total volume	pcu/hour
9.00 - 9.15	550	140	50	42	9	728	456		
9.15 - 9.30	430	120	25	35	8	640	385		
9.30 - 9.45	370	90	33	29	6	488	349.8		
9.45 - 10.00	370	120	33	30	8	515	378	2171	1568.8
10.00 - 10.15	380	90	37	29	5	514	358		
10.15 - 10.30	370	78	40	37	6	479	356.2		
10.30 -10.45	379	85	38	40	6	491	364		
10.45 - 11.00	270	75	30	25	2	352	252	1836	1330.2
11.00 - 11.15	89	60	29	29	3	185	181.3		
11.15 - 11.30	80	50	30	25	5	148	145.6		
11.30 - 11.45	95	40	38	28	5	168	161.6		

11.45 - 12.00	80	39	30	30	4	93	113.3	594	601.8
Afternoon									
2.00 - 2.15	50	39	25	12	2	130	128.8		
2.15 - 2.30	30	30	16	2	5	78	73.6		
2.30 - 2.45	20	29	29	20	3	74	83.2		
2.45 - 3.00	15	30	25	23	4	67	83.1	349	368.7
3.00 - 3.15	85	34	35	15	5	165	151.5		
3.15 - 3.30	75	22	39	9	6	142	125.9		
3.30 - 3.45	60	30	42	15	5	105	97.4		
3.45 - 4.00	65	25	29	14	2	120	106.1	532	480.9
Evening									
4.00 -4.15	89	48	35	30	15	203	206.5		
4.15 - 4.30	90	45	36	33	4	192	188.1		
4.30 - 4.45	200	43	29	30	6	204	201		

4.45 - 5.00	100	30	39	35	4	204	207	803	802.6
5.00 -5.15	1300	35	30	15	3	198	165		
5.15 - 5.30	90	35	40	35	1	141	141		
5.30 - 5.45	85	46	35	30	1	166	156		
5.45 - 6.00	90	35	37	25	1	158	139.9	663	601.9
total=	5237	2267	860	647	117	6948	5754.9		

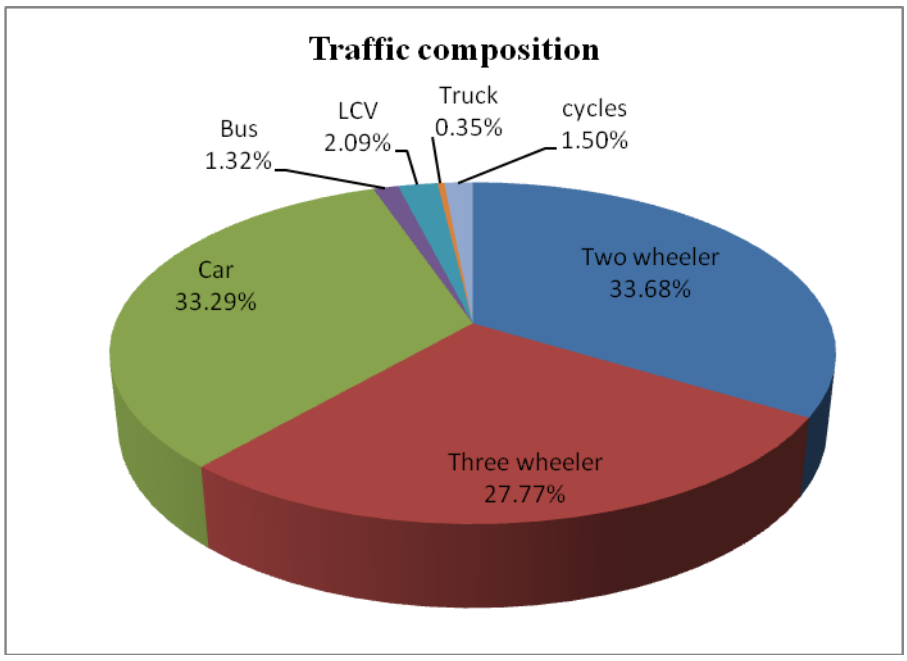
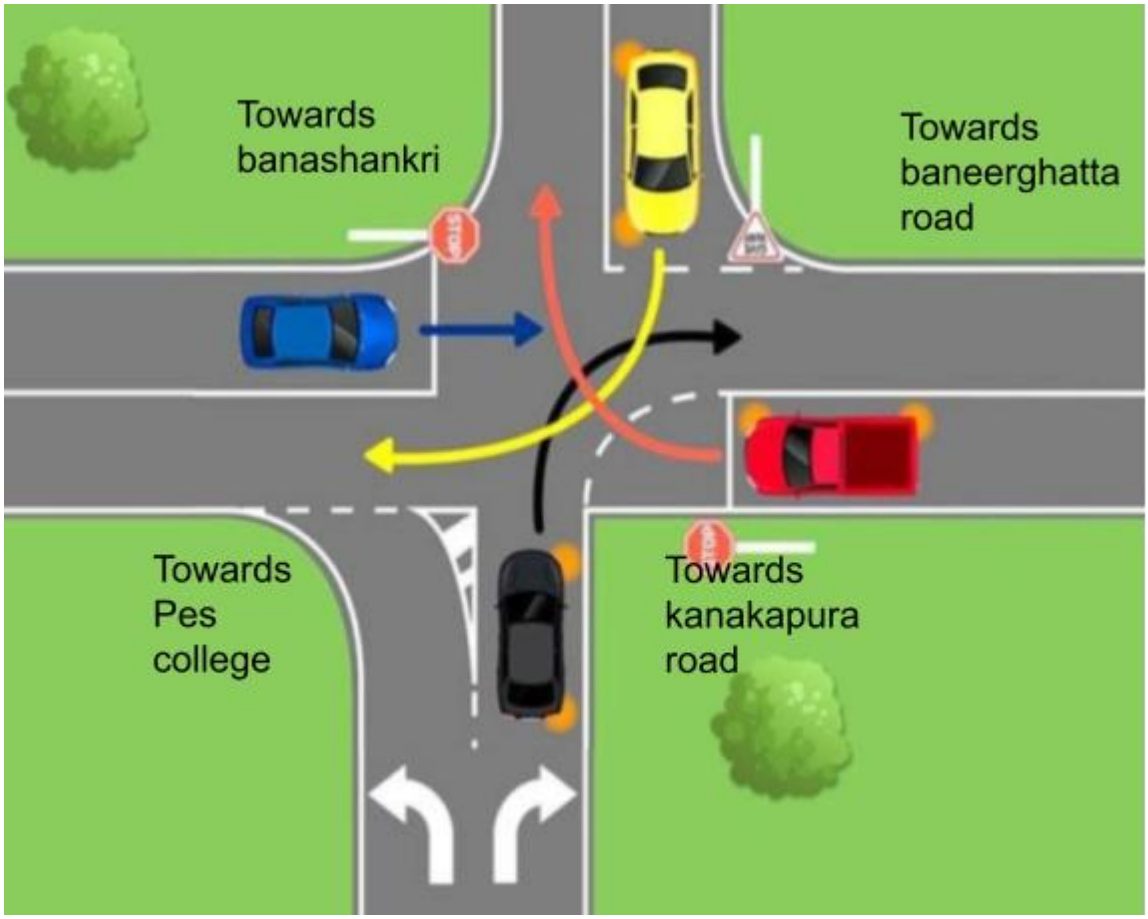


Table-4.12 Existing signal timing at Jp nagar junction

Junction name:-JP nagar		Date:28/04/2023 Time: 11:30pm			
From	To	Signal timings(sec)			Queue length(m)
		Green	Red	Amber	
kk cross	sarakki signal	100	150	3	101
	Towards pes college	169	90		
	towards baneerghatta road	120	150		
	towards banashankri	110	80		

Figure 5.8 Peak hour traffic at jp nagar junction



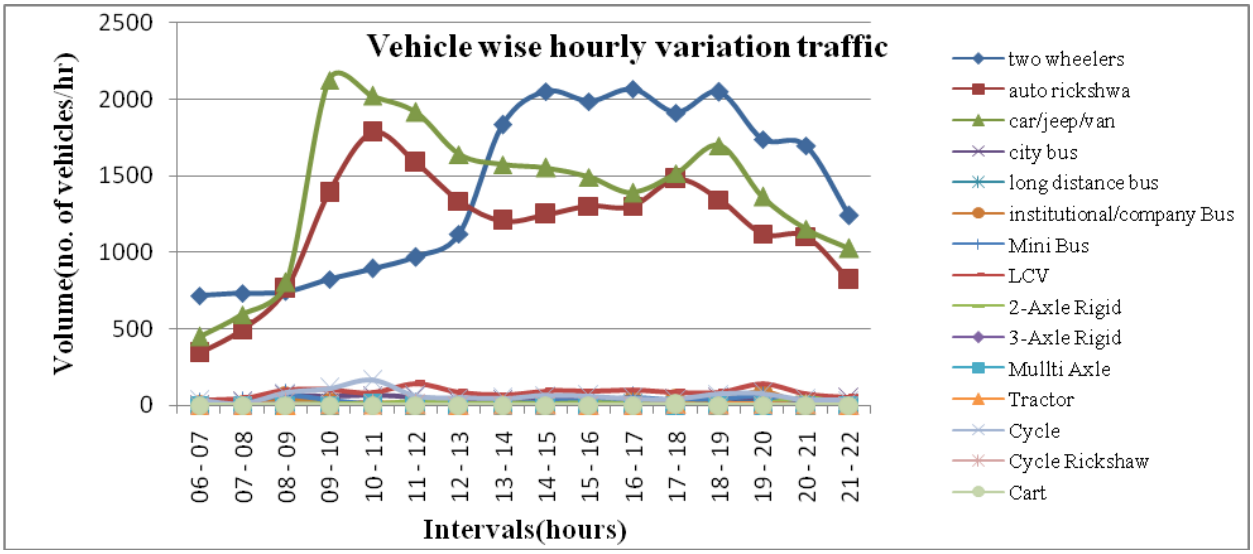
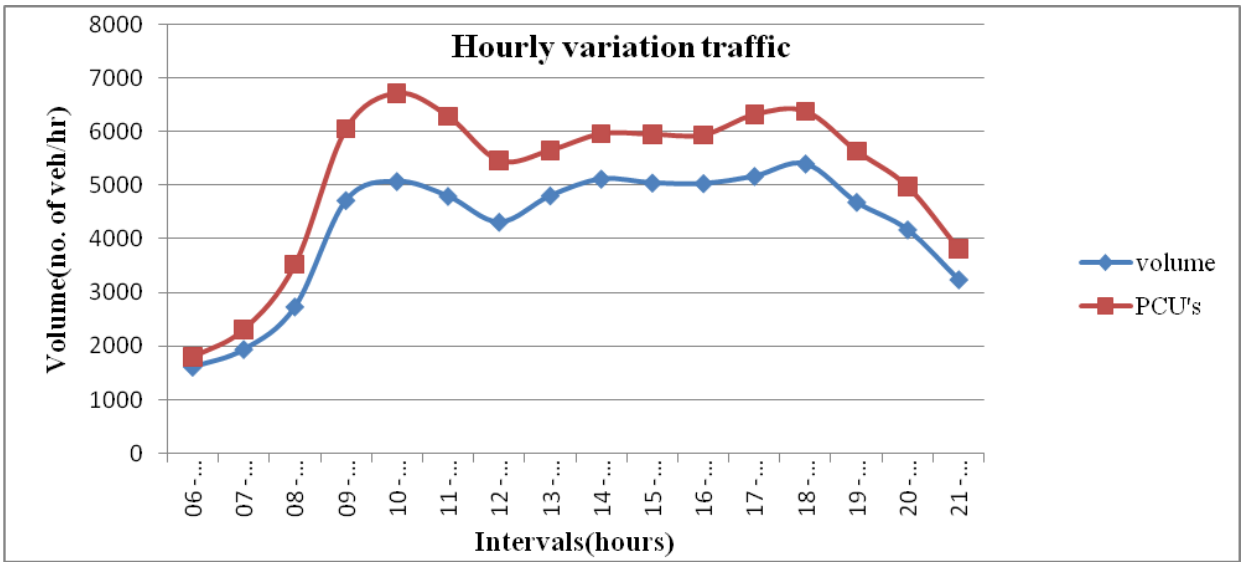


Figure 5.9 Vehicle wise hourly traffic variation traffic at jp nagar signal.



Total Cycle Time Calculation based on Webster's method

For peak hour traffic flow in Indian garage junction

$s_{(a)}$ = 7733 pcu $q_{(a)}$ = 2199

$s_{(c)}$ = 4800 pcu $q_{(c)}$ = 1265

$s_{(d)}$ = 6933 pcu $q_{(d)}$ = 2007 $y_{(a)} = q_{(a)} / s_{(a)}$ = 2199/5000 = 0.284

$y_{(c)} = q_{(c)} / s_{(c)}$ = 1265/4667 = 0.263 $y_{(d)} = q_{(d)} / s_{(d)}$ = 2007/4000 = 0.289

Y =y(a) + y(b) + y(c)

= 0.836

L = 2n + R
= 2*3+10
= 16

$$Co = \frac{1.5L + 5}{1 - Y} = \frac{1.5 * 16 + 5}{1 - 0.836}$$

= 180 sec

Pedestrian crossing time = 10 sec Amber time = 6 sec

CHAPTER-6
RESULTS AND CONCLUSION

Timing diagram of Jp nagar intersection

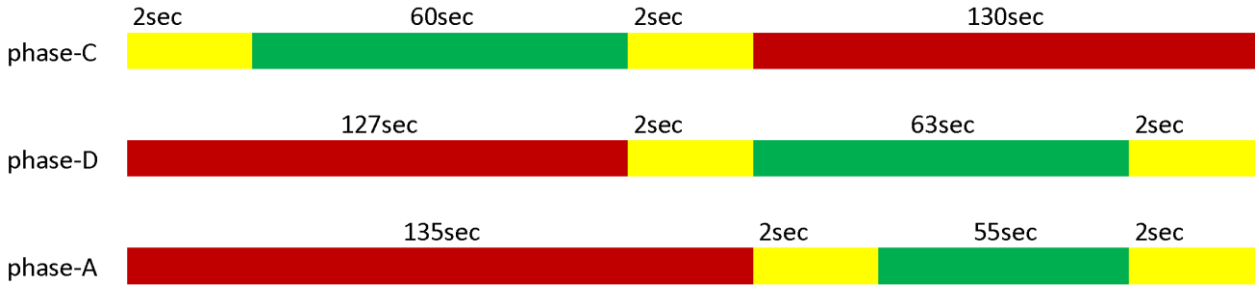


Table 6.1 Signal design detail intersection after synchronization

Sl.No	Name of Intersection	Distance(m)	Cycle Time Co(sec)	Green phase(sec)				V/C Ratio	LOS
				A	B	C	D		
1	Raghuvanahalli	490	196	55	-	60	63	0.836	D
2	KK cross	1600	151	30	55	50	-	0.778	D
3	JP nagar	1500	246	15	80	35	100	0.872	E

Table 6.2 Benefits of peak hour traffic in terms of money.

JUNCTION NAME	Fuel consumption (liters/hr)		Cost save(Rs)		CO2 emission(kg)	
	Petrol	Diesel	Petrol	Diesel	Petrol	Diesel
Raghuvanahalli	57	38	4282	1670	9848	4510
KK cross	66	33	4971	1474	11433	3980
Jp nagar	124	50	9389	2268	21594	6123
Total(per hr)	247	121	18642	3144	42875	14613

Discussion and conclusions:

Based on the analysis of the data, it can be said that the pedestrian crossing condition at an urban mid-block section location clearly results in a decrease in the mean speed of the vehicle, an increase in density, and a reduction in traffic flow.

1. The friction section's capacity at the mid-block section 1 site was evaluated at 1583 PCUs per hour per lane and the base section's capacity at 2277 PCUs per hour. And the percentage decrease in traffic capacity was 23.47%.
2. For the friction section, the capacity of the mid-block section 2 site was calculated at 1389 PCU/Hour/lane and for the base section at 1844 PCU/Hour. And the percentage drop in traffic capacity was 19.67%.
3. For the friction section, the capacity of the mid-block section 3 site was predicted to be 1632 (PCU/Hour/lane). (PCU/Hour) for base section. And the reduction in traffic capacity percentage registered as 12.78%.

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1. Mark R.Vikler and Narla Raj Kumar “System to Identify Movements At Signalized Intersections” Journal of transportation engineering(Reviewed by the Urban Transportation Division)
2. S.K. Khanna and C.E.G.Justo “Highway Engineering” Eighth Edition”
3. Guidelines For Capacity Of Urban Roads In Plain Areas “Indian Roads Congress”:106-1990
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