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LEVEL OF SERVICE AT UNSIGNALIZED T-INTERSECTION USING REGRESSION MODEL

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ABSTRACT

The qualitative measure reflects user perceptions of quality of service, comfort, and convenience. The T-junction for this study was controlled by the stop rule or in other names is two-way stop-controlled intersection (TWSC). For a two-way stop-controlled intersection (TWSC) intersection, the stop-controlled approaches are referred to as the minor road approaches. The most important parameters affecting the capacity and performance of unsignalized intersections are the critical gaps. Critical gaps are established by Highway Capacity Manual. Therefore, the critical gap is the difference between each intersection based on the geometry of the number of lanes; and the rounding area located near the intersection. At unsignalized intersections, vehicles generally do not follow lane discipline and ignore the rules of priority. Drivers generally become more aggressive and tend to cross uncontrolled intersections without considering the conflicting traffic. All these conditions cause a very complex traffic situation at unsignalized intersections which have a great impact on the capacity and performance of traffic intersections. The objective of these studies is to collect the data from intersections to evaluate the operational performances of the traffic volume count, Road geometry, turning movements, occupancy time, critical gap, capacity, and level of service (LOS). So, the data has been collected from Cyberabad City and peak hours. The research of location area for unsignalized T - Intersection traffic-related issues at the intersection such as traffic congestion, delay, occupation time, vehicular movement, level of service and capacity.

Keywords: *Un-signalized T- Intersection, Critical gap, gap acceptance, occupation time, vehicular movement, control delay, Level of service, capacity, conflicts method, Highway Capacity Manual (HCM 2010), and Regression Model.*

1. INTRODUCTION

Unsignalized intersections where traffic operates based on the priority of traffic movements. Capacity at unsignalized intersections is defined as a result of the essential capacity within ideal traffic conditions associated with various adjustment and correction factors, including the impact of the road environment, geometric design, and traffic conditions. The left-turning movement (in contrast with the straight or right-turn movements) from the minor street has, for example, the lowest priority according to the corresponding traffic laws in many countries. In Indian conditions, it is applied to the right turning movements. They are the major source of vehicular conflict resulting in delay, accident, and congestion. By improving the design and operation of the unsignalized intersection we can minimize the user cost delay. Improvement in design and operation largely depends on how accurately capacity and delay are estimated in response to alternative policies and styles. At Two Way Stopped Controlled (TWSC) intersections, the minor road is controlled by stop signs, and the approaches have not controlled any signs referred to as major street approaches. A three-legged intersection is taken into account to be a typical sort of TWSC intersection if the only minor street approach (i.e. stream of T- Intersection) is by unsignalized Intersection.

The three basic sorts of intersections are the three-leg or T-intersection (with variations within the angle of approach). The simplest and most common T-intersection is the private entrance or driveway. The relationships between traffic volumes and highway capacity, together with operating speeds, provide a measure of the level of service. At an unsignalized intersection, each driver must find a safe moment for the turning movement of the vehicle depending upon the traffic conditions and pertinent regulations. The most important modeling approaches are stochastic (gap acceptance theory) and statistical (regression analysis). For unsignalized intersections, traffic volumes are usually low and unstable and this is especially true for minor road approaches. As far as such intersections are concerned, the conventional methods of traffic conflict analysis are no longer appropriate. In consideration of the deficiency discussed above, a new method of data collection for traffic conflict analysis, which was carried out with the aid of a video camera, was put forward. Instead of using data aggregated within hours, the method for traffic conflict analysis was based upon data recording events and indexes within 15 seconds. Using the method of the safety performance of a three-leg unsignalized intersection was evaluated by analyzing traffic conflicts between vehicles on road and turning vehicles from a minor road. Conflict method is developed to overcome these shortcomings. Surveillance equipment is used to obtain the required data, such as traffic volume and occupation time. The occupation time of the vehicle is used to calculate the capacity of vehicular movements for each conflict group. Consequently, the situation at unsignalized intersections is chaotic and unpredictable making maneuvering very unsafe. Such a situation also makes it difficult to evaluate unsignalized intersections. Unlike Highway Capacity Manual (HCM 2010), many developing countries including India do not have any standard manual for capacity analysis of unsignalized intersections. To evaluate the safety and performance of unsignalized intersections, it is important to study various traffic characteristics, such as critical gap, gap acceptance, occupation time, vehicular movement, control delay, Level of service, capacity, and conflicts methods.

2. LITERATURE REVIEW

Ashalatha et al. (2011) [1] estimated the critical gap by some of the existing methods like lag, Harders, logit, modified Raff, and Hewitt methods at unsignalized T-intersection. The critical gap variation by these methods highlights the incapability of the existing methods to address the mixed traffic conditions. An alternate procedure for street estimation of critical gap making use of clearing behavior of vehicles in conjunction with gap acceptance data is proposed**.** The situation is worsened by heterogeneous traffic, a mix of motorized and non-motorized modes **(Prasetijo, 2007)** [2] Therefore, the conflict method is developed to overcome the problems in the gap-acceptance method. This method is also known as the additive conflict flow (ACF) method. **Brilon and Wu (2002)** [3] used the term t_B, q, m and t_B, q, i alternatively to describe the occupancy time of vehicles at the conflict area. Another parameter to be considered in the conflict method is the blocking time of conflict area due to approaching vehicle, t_B, a. Thus, the objectives of this study are to determine the t_B, q of the vehicle, and to evaluate the performance of the unsignalized intersection based on the occupation time values. **Brilon and Wu (2002)** [4] stated that the gap-acceptance method has a few drawbacks. It does not consider the driver behavior, particularly on the compliance with priority rules. The forced gap is caused by an aggressive driver, and the polite behavior of drivers that purposely provide gaps are not following the rules of priority. **Hagring (2000)** [5] calculated different critical gaps for two major lanes using the maximum likelihood method. They observed that critical gaps differ between the two major lanes. **Wu (2000)** [6] stated that it is easier to consider the distribution of traffic flow rates, the number oflanes pedestrians on different approaches, and flared approaches.

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3. RESEARCH METHODOLOGY

It is essential to collect the data at different selected locations for the level of services (LOS) and their characteristics for unsignalized Intersection. This methodology includes identifying the level of services, critical gap, gap acceptance, delay, queue length, occupation time, vehicular movement, and unsignalized intersections. To accomplish the objective of the study, Hyderabad city was selected three areas of research for Unsignalized T Intersection at the particular junction of ***Gaddianaram- Dilsukhnagar, Lal Darwaza-Balagunj, Liberty- Basheerbagh***. The methodology includes identifying the traffic operational conditions at Un-Signalized T Intersection and finding the problems faced earlier. Estimate the critical gap with various critical gap methods like Raffs, Harder, Wu, and Proposed method for unsignalized Intersection. After defining the objective, the study location has been selected to record the required data like control delay, Queue Length, and Level of service of minor and major streams. There are various methods the data was collected using a perception survey and Video-graphic survey for calculating the data. In this study, both empirical methods and multiple linear regression models for the vehicular flow of directions, movement, the proportion of traffic streams, flares on the minor streets. Developing a level of service for Unsignalized T Intersection for empirical methods and Multiple Regression Model.

4. SELECTION OF UNSIGNALIZED T- INTERSECTION AND DATA COLLECTION

In the present study traffic data was collected for morning and evening peak hours from the traffic police department and at each unsignalized T- Intersection for selected three areas and data has been collected perception survey and video graphic survey for Morning and Evening peak hours' traffic is determined. The intersection was selected in such a way that they have fair geometry and the least interference by pedestrians and parked vehicles. This selected area was a major conflict in the turning movements in different directions.In unsignalized T- Intersections several accidents and traffic congestion issues are more in particular selected areas. So, the selected areas to reduce traffic congestion and accidents should be the diversion of turning movements and occupation time.

The turning movements at unsignalized T- Intersection has to merge, diverging depending upon the geometry design, occupation time, critical gap, gap acceptance, delay, and level of service. Major traffic problems occurring at unsignalized T- Intersections in Hyderabad city were identified in this particular selected locations are ***Gaddianaram- Dilsukhnagar, Lal Darwaza- Balagunj, Liberty- Basheerbagh***.

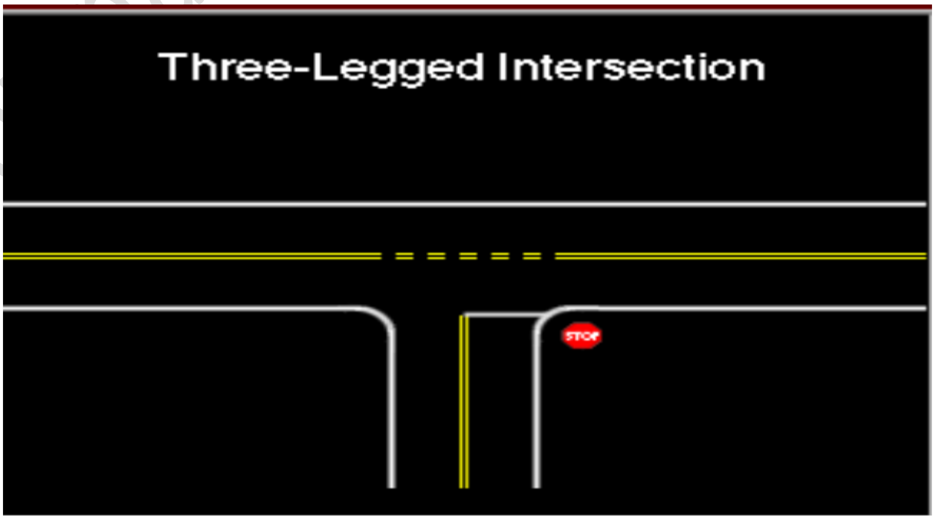

Figure 1 Typical Schematic for Three – Leg Intersections or T- Intersection for a stop sign

Figure 2 Data collection for three location areas of uninterrupted traffic flow for Gaddianaram- Dilsukhnagar, Lal Darwaza- Balagunj, Liberty- Basheerbagh.

5. DATA ANALYSIS AND RESULTS

The video-graphic data collected from the site location is analyzed by playing the video for observed at a one-hour count interval of data from the field in the datasheet for the selected locations of ***Gaddianaram- Dilsukhnagar, Lal Darwaza- Balagunj, Liberty- Basheerbagh*** in the Hyderabad city. This table includes the Morning and Evening Peak hours for Unsignalized T Intersection for vehicles (veh/hr) and proportions of through vehicles (veh/hr) including 2-wheelers, 3-wheelers, 4-wheelers, Heavy commercial vehicles, (Hcv), and others (Bicycles).

For the selected intersections, the data is collected by videography technique. Video recording is done for two hours in the morning (8 AM to 10 AM) and evening hours (4 PM to 6 PM) for three intersections during peak hours. The traffic parameters like traffic volume, vehicle entry time, vehicle exit time, critical gap, follow-up time are extracted after the video recording is done.

The peak hour volume of locations for i.e. Gaddiannaram- Dilsukh Nagar Lal Darwaza– Balagunj and Liberty – Basheerbagh. It is noted that the peak hour volumes are 4298 PCU and 4684 PCU respectively. Peak Hour flow was calculated by video data collected from the Police department, Hyderabad.

According to Brilon and Wu (2002), a conflict group consists of several movements that cross the same area within an intersection. Generally, the capacity of a minor stream is expressed by Eq. (1). On the other hand, the proportion of time spent by discharging vehicles in the conflict area is calculated using Eq. (2). The conflict area can be blocked by the approaching vehicles of higher priority. The proportion of time the approaching vehicle is blocking the conflict area is defined by Eq. (3).

$$C_m = C_{max,m} \cdot p_0 \qquad (1)$$

Where C_m = Capacity of movement m [veh/h]

$C_{max,m}$ = Maximum possible capacity of movement m [veh/h]

$= 3600 / t_{b,q,m}$

$t_{B,q,m}$ = Occupation time of movement m [s]

$p_0 = Pr$ (no blockage) [-]

$$B_{q,m} = \frac{Q_m \cdot t_{B,q,m}}{3600} \qquad (2)$$

Vol 13, Issue 03, MARCH /2022

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Where

Q_m=Traffic demand of movement *m* [veh/h]
$t_{B,q,m}$=Occupation time of movement *m* [s]
$B_{q,m}$=Proportion of occupancy by discharging vehicle *m* [-]with the restriction of $Q_m \cdot t_{B,q,m}$ ”3600

$$B_{q,m} = \frac{Q_m \cdot t_{B,q,m}}{3600} \qquad (3)$$

Where

$t_{B,a,m}$=Approaching time of movement *m* [s]
$B_{a,m}$= Proportion of period the conflict area is blocked by approaching vehicle *m* [-].

The required traffic data were collected at Unsignalized T Intersection for conflicts points while merging and diverging each direction depending upon the occupation time and vehicular movement for unsignalized T-Intersection for selected locations. This procedure requires a priority of traffic volumes, the potential capacity of each movement, adjustments of potential capacities based on impedance factors. The required input data is the volume of each movement, critical gap & Follow time.

5.1 ROAD GEOMETRIC DATA AT STUDY LOCATIONS.

Table 1 Average composition of Traffic Volume and Conflicting Traffic Volume

Road geometric data			
Facility Location	**1. Gaddiannaram - Dilsukhnagar**	**2. Lal Darwaza Balagunj**	**3. Liberty- Basheerbagh**
Carriageway Width	14	14	15.5
Type of intersection	T – Intersection	T – Intersection	T – Intersection
Bus Bay	Yes	Yes	Yes
Median Width	1 Meter	0.5 Meter	1 Meter
Foot Path	Yes	Yes	Yes
Street Light	Yes	Yes	Yes

Vol 13, Issue 03, MARCH /2022

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Table 2 Data extraction of Intersection for Gaddianaram- Dilsukhnagar during Peak hours of Morning and Evening

Intersection	Directions	Cycles	2W	3W	4W	BUS	LCV	HCV	TOTAL
Intersection Gaddianaram – Dilsukhnagar (Morning Hours)	EW	48	3876	2085	1560	356	124	185	8234
	WE	54	5245	2784	1737	412	189	112	10533
	ES	32	895	368	162	2	3	0	1462
	WS	10	248	182	234	2	2	0	678
	SW	12	132	87	98	2	3	0	334
	SE	28	1296	125	169	3	16	0	1637
	% Share	0.80	51.10	24.61	17.30	3.39	1.47	1.29	100.00
Intersection Gaddianaram – Dilsukhnagar (Evening Hours)	EW	38	3124	1486	1242	452	164	189	6695
	WE	26	4326	1782	1985	589	196	234	9138
	ES	8	897	363	325	28	18	3	1642
	WS	6	465	234	189	59	12	2	967
	SW	18	389	162	104	3	8	3	687
	SE	15	1128	114	98	6	24	6	1391
	%Share	0.54	50.33	20.18	19.21	5.54	2.05	2.12	100.00

In the morning peak hour for unsignalized intersection from gaddianaram- dilsukhnagar the maximum value from west to east direction is 10533 and minimum value from south to west direction is 334.

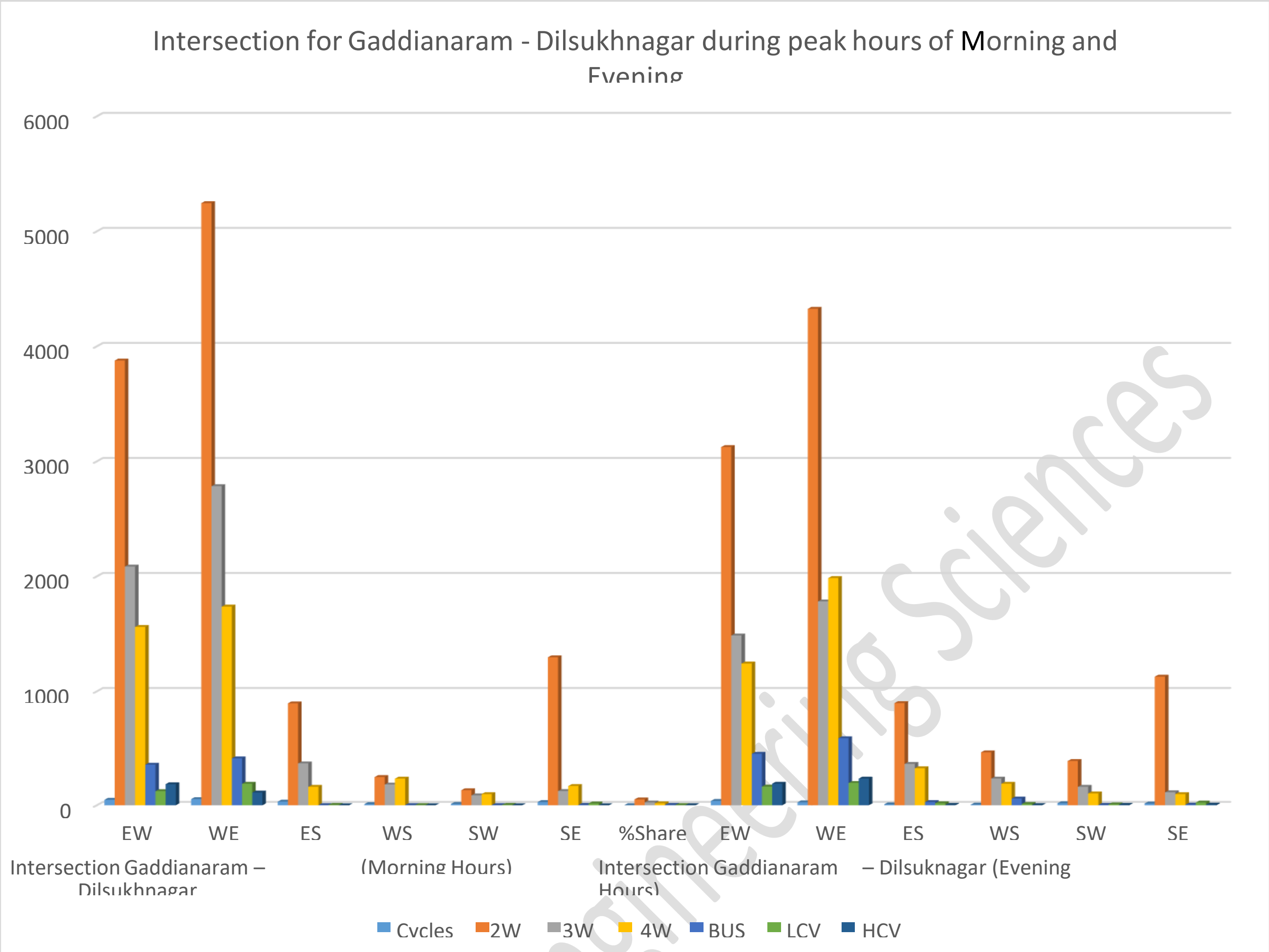


Figure 1 Graphically Vehicular Movement at T- Intersection at Gaddianaram – Dilsukhnagar

Table 3 Data extraction of Intersection for Lal darwaza- Balagunj during Peak hours of Morning and Evening

Intersection	Directions	Cycles	2W	3W	4W	BUS	LCV	HCV	TOTAL
Intersection	EW	40	3889	2078	1666	428	138	194	8411
Lal Darwaza – Balagunj	WE	52	5986	2784	1878	546	195	225	11566
	ES	28	685	325	178	2	3	0	1221
(Morning Hours)	WS	12	232	194	212	2	2	0	654

	SW	08	168	114	102	2	2	0	396
	SE	20	1296	168	159	2	14	0	1659
	%Share	0.66	51.2	23.68	17.54	4.10	1.48	1.33	100.00
Intersection Laldarwaza – Balagunj (Evening Hours)	EW	46	3784	1536	1358	473	187	208	7592
	WE	32	4456	1758	2043	602	204	287	9382
	ES	10	942	394	368	22	14	3	1753
	WS	8	497	286	192	44	8	2	1037
	SW	18	416	178	106	3	6	3	730
	SE	16	1289	137	128	3	20	3	1596
	%Share	0.58	51.53	19.41	18.99	5.19	1.98	2.29	100.00

In the morning peak hour for unsignalized intersection from Lal darwaza- Balagunj the maximum value from west to east direction is 11566 and minimum value from south to west direction is 396.

JES
Journal of Engineering Sciences

Vol 13, Issue 03, MARCH /2022

ISSN NO:0377-9254

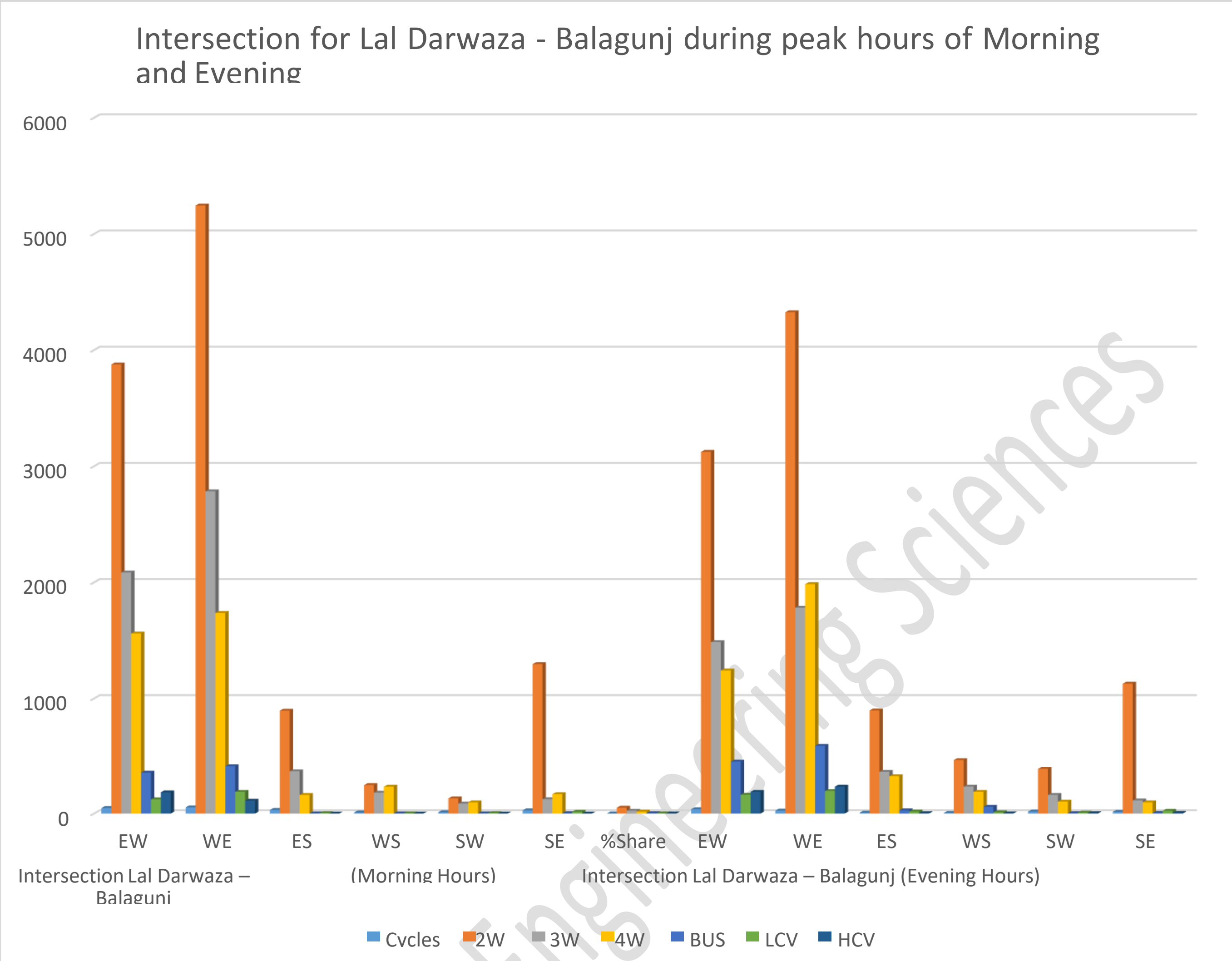


Figure 2 Graphically Vehicular Movement at T- Intersection at Lal Darwaza – Balagunj

In the evening peak hour for unsignalized intersection from Lal darwaza- Balagunj the maximum value from west to east direction is 9382 and the minimum value from south to west direction is 730.

Table 4 Data Extraction of Intersection for Liberty – Basheerbagh during Peak hours of Morning and Evening

Intersection	Directions	Cycles	2W	3W	4W	BUS	LCV	HCV	TOTAL
Intersection Liberty – Basheerbagh (Morning Hours)	EW	44	3956	2154	1758	452	134	195	8693
	WE	58	5356	2843	1814	468	177	126	10842
	ES	36	936	378	179	6	5	0	1540
	WS	16	248	182	234	8	6	0	694
	SW	10	145	114	138	4	8	0	419
	SE	30	1374	154	196	6	16	0	1776
	%Share	0.80	50.13	24.30	18.02	3.93	1.44	1.33	100.00

Journal of Engineering Sciences

Vol 13, Issue 03, MARCH /2022

ISSN NO:0377-9254

Intersection Liberty – Basheerbagh (Evening Hours)	EW	36	3253	1547	1351	472	178	192	7092
	WE	28	4326	1782	2046	592	196	264	9234
	ES	12	897	363	347	32	20	8	1679
	WS	14	465	234	211	64	16	6	1010
	SW	20	389	162	128	6	12	4	721
	SE	24	1128	114	154	6	28	6	1460
	%Share	0.63	49.33	19.82	19.98	5.52	2.12	2.26	100.00

In the morning peak hour for unsignalized intersection from Liberty - Basheerbagh the maximum value from west to east direction is 10842 and the minimum value from south to west direction is 419. In the evening peak hour for unsignalized intersection from Liberty - Basheerbagh the maximum value from west to east direction is 9234 and the minimum value from south to west direction is 721.

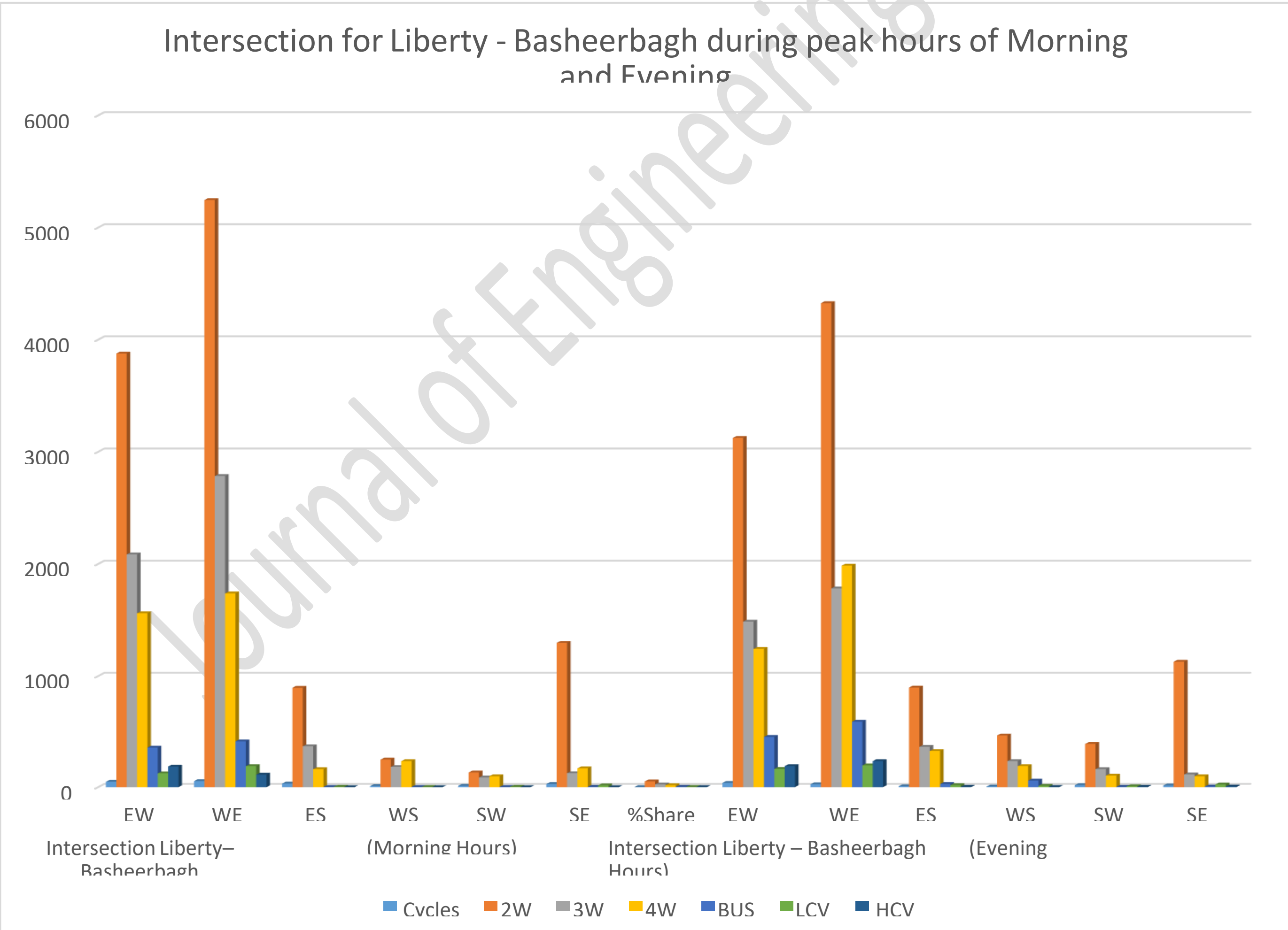


Figure 3 Graphically Vehicular Movement at T- Intersection at Liberty– Basheerbagh

Journal of Engineering Sciences
Vol 13, Issue 03, MARCH /2022
ISSN NO:0377-9254

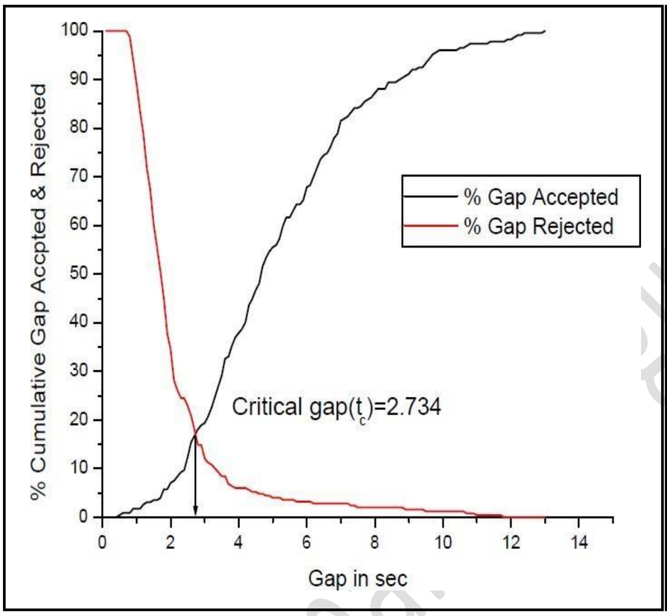
5.2 DATA ANALYSIS AND MODEL DEVELOPMENT

5.2.1 Level of Service and Capacity for Critical Gap with Different Methods

The Critical gap is T_c, is defined as the minimum gap required in major stream for a minor stream vehicle to cross the intersection safely. Thus, the driver's critical gap is the minimum that would be acceptable. A particular driver would reject any gaps if the gap is less than the critical gap and he would accept the gap if it is greater than or equal to the critical gap. The follow-up time T_f is defined as the time interval between the departure of one vehicle from the minor street and the departure of the next vehicle using the same major street headway under continues queuing on the minor street.

5.3 Raffs Method

Based on Raffs definition, the critical gap L is the gap which has the property that the number of accepted gaps shorter than L is the same as the number of rejected longer than L. This could be found from the intersection of %Gap Accepted and %Gap Rejected Curves. The estimated critical gaps of intersection A by using raffs is shown in figure 4 and figure 5 as mentioned below.



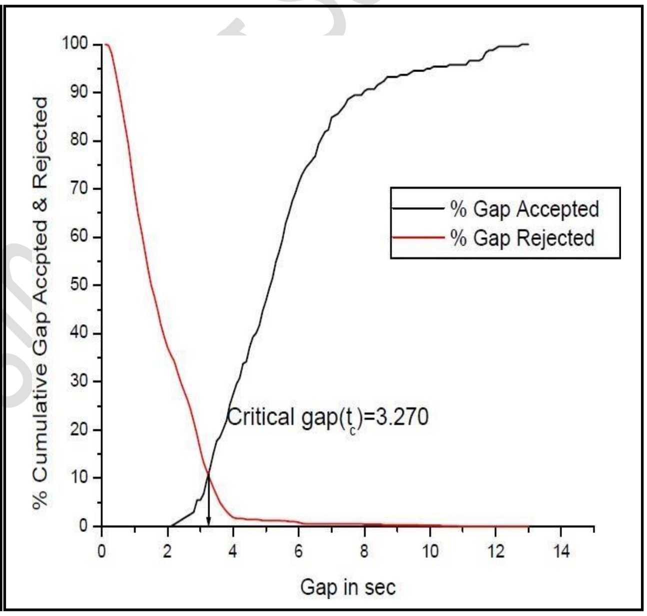


Figure 4 Critical gap estimation for Major Right turns Figure 5 Critical gap estimation for Minor Right turn

5.4 Harder Method

This method is quite equal to Lag method. In this method the critical gap is estimated on the basis of Accepted gap data only where as in lag method it is on the basis of lag data. Here the probability of accepting gap is measured using the equation (1) and the time of interval is assumed as Δt=0.5 seconds.

$$r_i = \frac{A_i}{N_i} \tag{1}$$

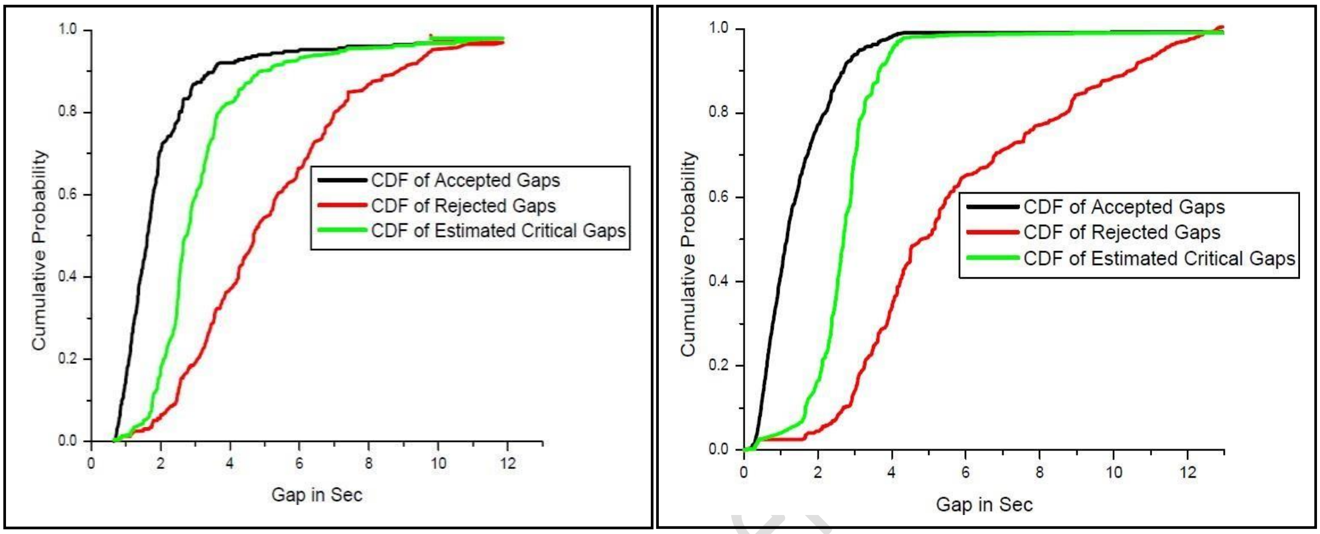
Where, A_i is the number of accepted gaps during time interval i and N_i is the total number of observed gap

JES Journal of Engineering Sciences
Vol 13, Issue 03, MARCH /2022
ISSN NO:0377-9254

during interval i.

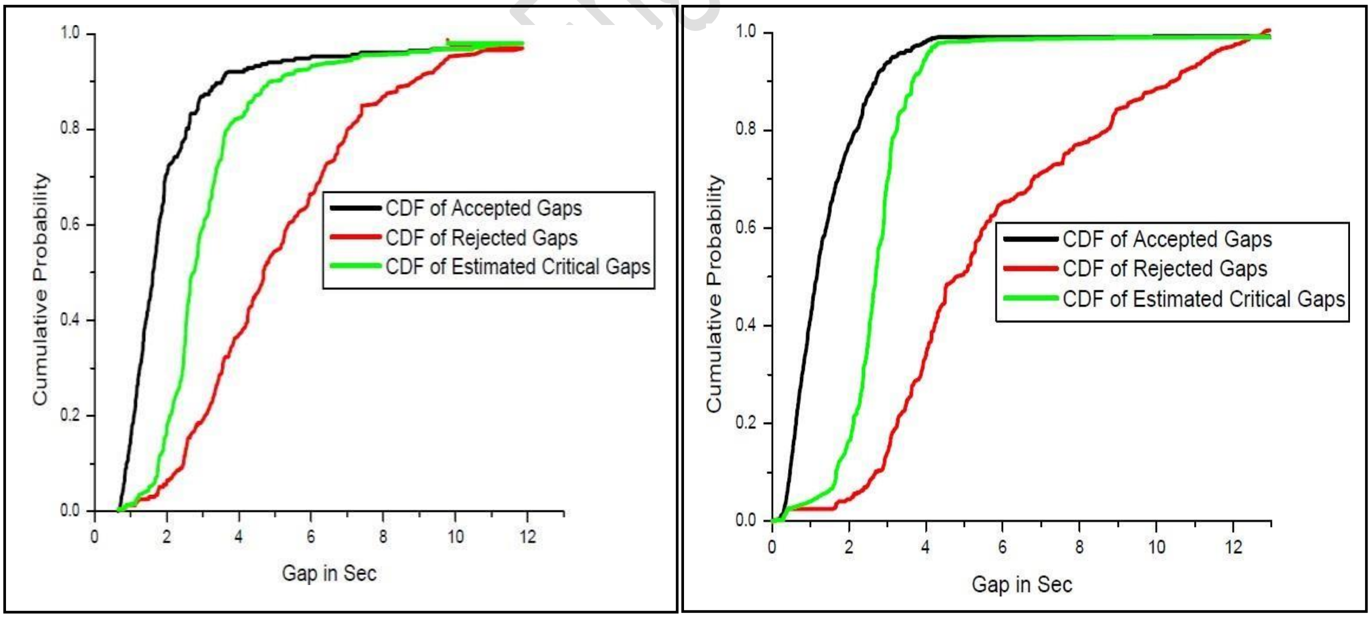
5.5 Macroscopic Probability Equilibrium Method by Wu

The proposed model based on the equilibrium probability of accepted and rejected gaps. This model considers all relevant gaps and produce empirical probability distribution function of critical gap directly. And it is giving similar results when comparing with maximum likelihood method (MLM).The main use of this model is it provides true average of critical headway, and it does not require any predefined distribution function of critical gaps. And this method we can easily implemented in Excel sheet.



(a)Critical gap estimation for Major Right turn (**b**) Critical gap estimation for Major Left turns

Figure 6 Cumulative Distribution Function (CDFs) of Accepted, Rejected & Critical gaps for Gaddianaram – Dilsukhnagar Unsignalized T – Intersections.



(**a**) Critical gap estimation for Major Left turn (**b**) Critical gap estimation for Major Left turns

Figure 7 Cumulative Distribution Function (CDFs) of Accepted, Rejected & Critical gaps for Intersection Gaddianaram – Dilsukhnagar

It is proposed about the distribution function $F_c(t)$ lies between the distribution functions of rejectedgaps $F_r(t)$ and accepted gaps $Fa(t)$ as said by the Wu.so that the difference of all accepted and all rejected gaps critical gap is minimum. To calculate the critical gap the function given in equation3 should be minimized

$$\text{Min } [\sum_{i=1}^{n} \{\text{LOS } (Tc\text{-}Ri) + \text{LOS } (Ai\text{-}Tc)\}] \qquad (2)$$

Where, Ai =Accepted gap by ith entering vehicle (seconds) Ri =Highest rejected gap by ith entering vehicle(seconds) Tc= Critical gap value in seconds.

6. RESULTS AND DISCUSSION

The stepwise analysis of a collection of data, extraction of traffic volume, accepted and rejected gaps calculation and plotting the critical graph, Capacity estimation, and determination of LOS explains the procedure of the Highway Capacity Manual (HCM) method. Both Highway Capacity Manual (HCM) method and Raff's method were analyzed to investigate the potential factors of the methods and compared.

The peak hour traffic of the Unsignalized Gaddianaram - Dilsukhnagar T - Intersection is 4102 PCU Lal Darwaza - Balagunj T - Intersection is 4876 PCU and Liberty - Basheerbagh T – Intersection is 5643 PCU under mixed traffic conditions. The capacity and LOS of intersection Gaddianaram - Dilsukhnagar calculated from Highway Capacity Manual (HCM) method is 845 veh/hr with v/c ratio as 0.753 and LOS D. The capacity and LOS of intersection Lal Darwaza - Balagunj calculated from Highway Capacity Manual (HCM) method is 647veh/hr and V/C ratio as 0.535 and LOS D. The critical gap of intersection Gaddianaram - Dilsukhnagar, intersection Laldarwaza - Balagunj were observed as 4.29 and 4.02 sec respectively for vehicles traveling from minor road to major road right turns and intersection Liberty - Basheerbagh were observed as 3.56 and 3.0 sec respectively for vehicles travelling from minor road to major road right turns. Raff's method explains the critical gap of intersection Gaddianaram - Dilsukhnagar, intersection Laldarwaza - Balagunj as 4.35 and 3.90 respectively for vehicles travelling from minor road to major road right turns and intersection Liberty - Basheerbagh as 3.62 and 2.78 respectively for vehicles travelling from minor road to major road right turns.

Table 5 Geometry Design for unsignalized T- Intersection from Gaddianaram - Dilsukhnagar

Geometry	**Gaddianaram Dilsukhnagar T – Intersection**		
Movement	Major Left (1)	Major Right(7)	Minor Left(5)
Adjustment For Base Critical Gap	2.4	3.2	6.4
Critical Gap	2.0	4.56	9.2s
Heavy Vehicle Adjustment Factor	0.48	0.62	0.90
Adjustment Factor 'a'	0.9	1	0.8
Adjustment Factor 'b'	1.4	2.25	5.4
Capacity	790	858	1400
V/C	0.69	0.77	0.86
LOS	D	D	E

In geometry design for unsignalized T – Intersection from Gaddianaram – Dilsukhnagar the capacity flow of traffic in turning movements is higher in the minor left turn of the vehicle and lower in the major left turn of the vehicle.

JES Journal of Engineering Sciences

Vol 13, Issue 03, MARCH /2022

ISSN NO:0377-9254

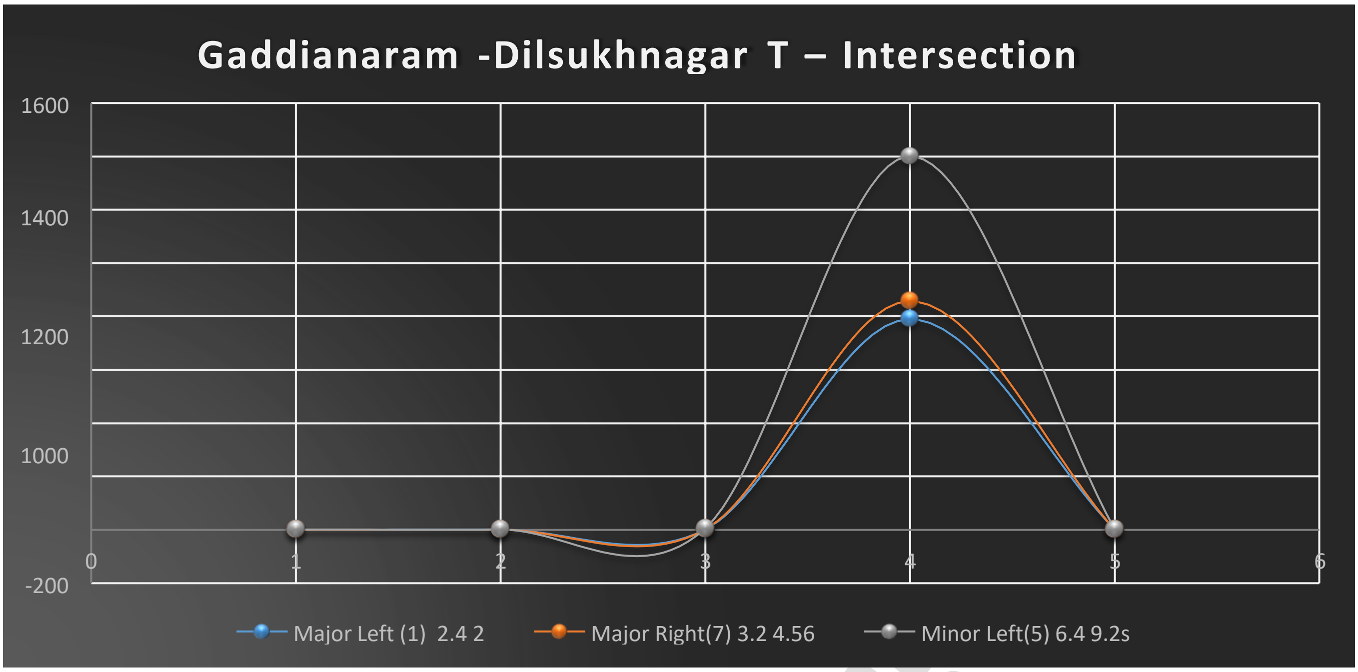


Figure 8 Unsignalized T- Intersection from Gaddianaram – Dilsukhnagar

The above figure 8 describes the turning movement of the traffic stream in a major and minor road in particular junction areas. As per the graph volume and capacity is more at peak hour at the gaddianaram –dilsukhnagar location.

Table 6 Geometry Design for unsignalized T- Intersection from Laldarwaza – Balagunj

Geometry	**Laldarwaza – Bala gunj T – Intersection**		
Movement	Major Left (1)	Major Right(7)	Minor Left(5)
Adjustment For Base Critical Gap	2.3	3.2	7.6
Critical Gap	1.8	487	9.4s
Heavy Vehicle Adjustment Factor	0.56	0.68	0.92
Adjustment Factor 'a'	0.9	1.2	0.8
Adjustment Factor 'b'	1.64	2.20	7.4
Capacity	840	946	1600
V/C	0.73	0.80	0.92
LOS	D	D	E

In geometry design for unsignalized T – Intersection from Lal Darwaza – Balagunj the capacity flow of traffic in turning movements is higher in the minor left turn of the vehicle and lower in the major left turnof the vehicle.

Vol 13, Issue 03, MARCH /2022

ISSN NO:0377-9254

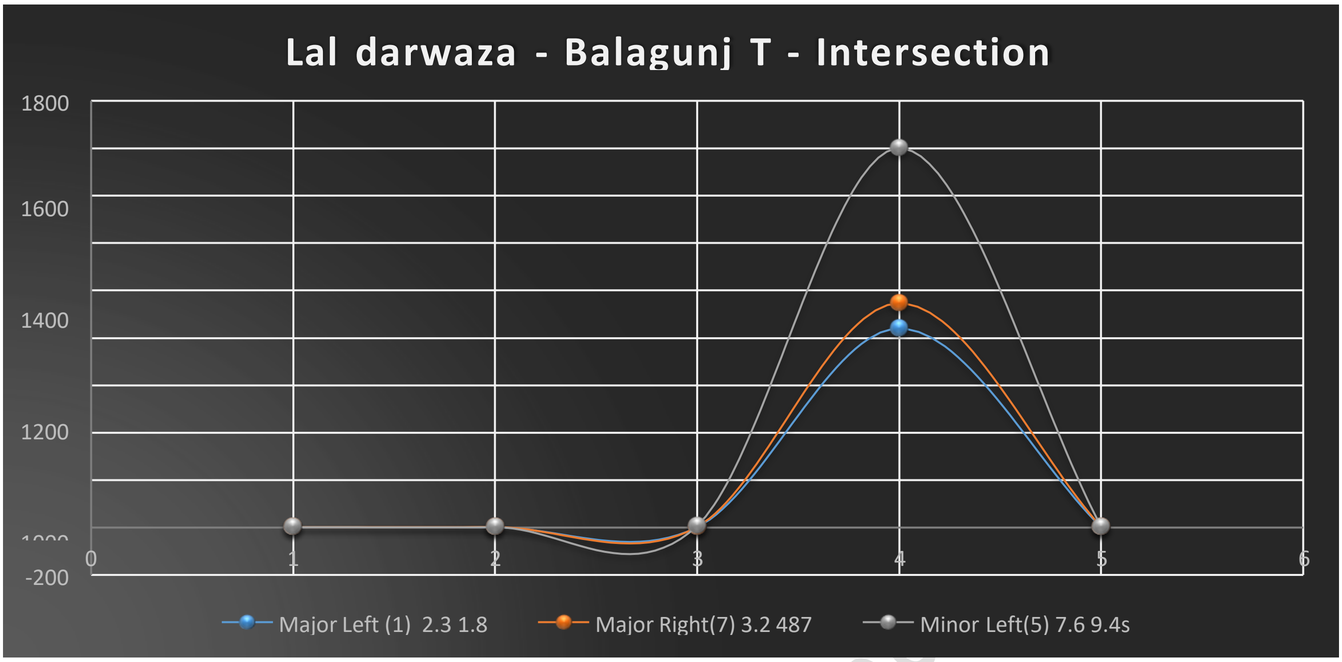


Figure 9 Unsignalized T- Intersection from Lal Darwaza – Balagunj

The above figure 9 describes the turning movement of the traffic stream in major and minor roads in traffic conditions. As per the graph volume and capacity are increased at peak hour at the Lal Darwaza – Balagunj location.

Table 7 Geometry Design for unsignalized T- Intersection from Liberty – Basheerbagh

Geometry	**Liberty T – Intersection**		
Movement	Major Left (1)	Major Right(7)	Minor Left(5)
Adjustment For Base Critical Gap	2.9	4.2	8.2
Critical Gap	1.9	5.24	8.6s
Heavy Vehicle Adjustment Factor	0.62	0.79	0.94
Adjustment Factor 'a'	0.9	1.2	1.0
Adjustment Factor 'b'	1.42	2.23	7.8
Capacity	790	862	1500
V/C	0.72	0.88	0.92
LOS	D	E	E

In geometry design for unsignalized T – Intersection from Lal Darwaza – Balagunj the capacity flow of traffic in turning movements is higher in the minor left turn of the vehicle and lower in the major left turnof the vehicle.

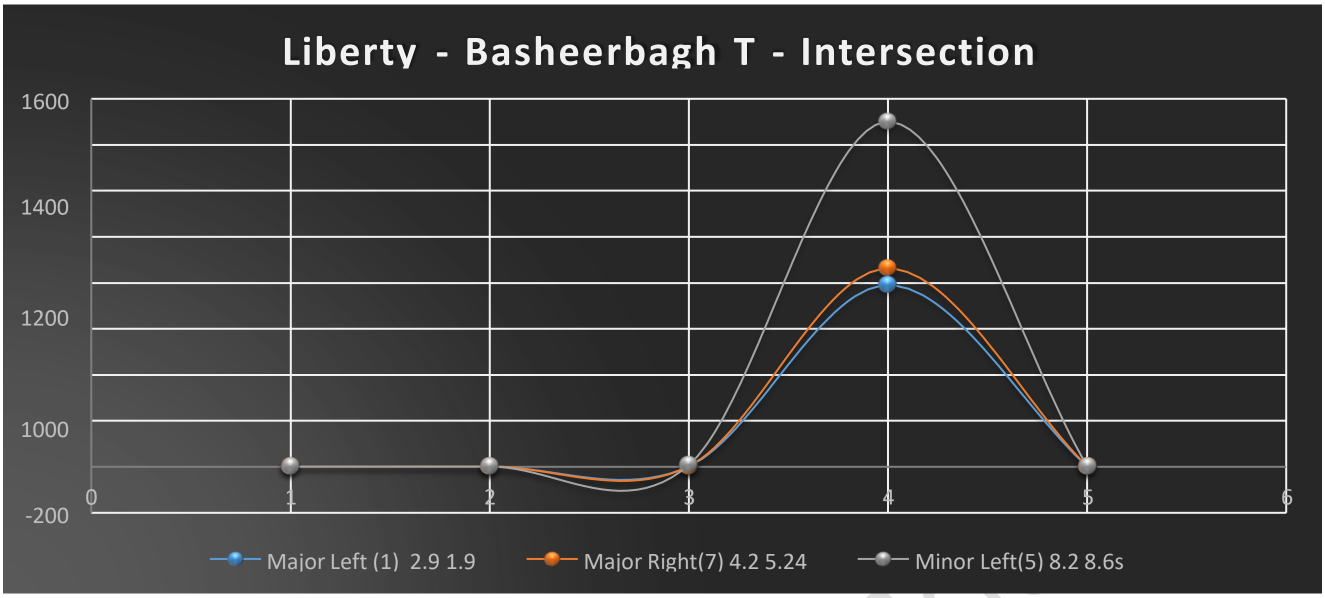


Figure 10 Unsignalized T- Intersection from Liberty– Basheerbagh

The above figure 10 describes the turning movement of the traffic stream in major and minor roads in traffic conditions. As per the graph volume and capacity are increased at peak hour for a minor left turn in turning movement for unsignalized T- Intersection at Liberty – Basheerbagh location.

6.1 Critical Gaps for Unsignalized Intersection

These critical gaps are estimated by considering all vehicle types i.e. 2W, 3W, 4W& Heavy commercial vehicle for each intersection, it is found that with an increase in vehicle size the critical gap is increased. And the critical gap is dependent on the space occupied by the vehicle category. And they obtained field critical gap by different methods under heterogeneous traffic conditions is also lower than the critical gap values suggested in Highway Capacity Manual (HCM 2010). From the obtained results, it is observed that the critical gap values obtained by the harder method are higher when we compared them with other methods. Almost similar values areobtained for Raffs & Wu methods.

Table 8 Estimated critical gap values & Follow up times of each intersection

Intersection	Movement	Critical gap by various method				Follow Uptime
		Raffs	Harder	Wu	Unsignalized T-Intersection	
Gaddianaram - Dilsukhnagar	Minor Left	1.786	2.104	1.660	1.690	3.724
	Minor Right	2.820	3.562	3.254	2.714	3.996
	Major Right	2.924	3.647	2.869	3.128	3.780
Lal Darwaza - Balagunj	Minor Left	2.214	2.784	2.421	2.163	3.694
	Minor Right	2.874	4.865	3.246	3.686	4.487
	Major Right	3.430	3.646	3.284	2.865	4.109
Liberty - Basheerbagh	Minor Left	1.314	1.934	1.285	1.304	3.268
	Minor Right	2.470	2.812	2.542	2.228	3.192
	Major Right	2.520	4.858	2.516	2.94	3.478

Intersection for Gaddianaram - Dilsukhnagar, capacity, when we compared with different critical gap methods during peak hours for the capacity estimation with raffs critical gap method, is giving lower values compared to other methods because of higher critical gap values. And the minor left and minor rights turn have lower capacities because of higher conflicting volume.

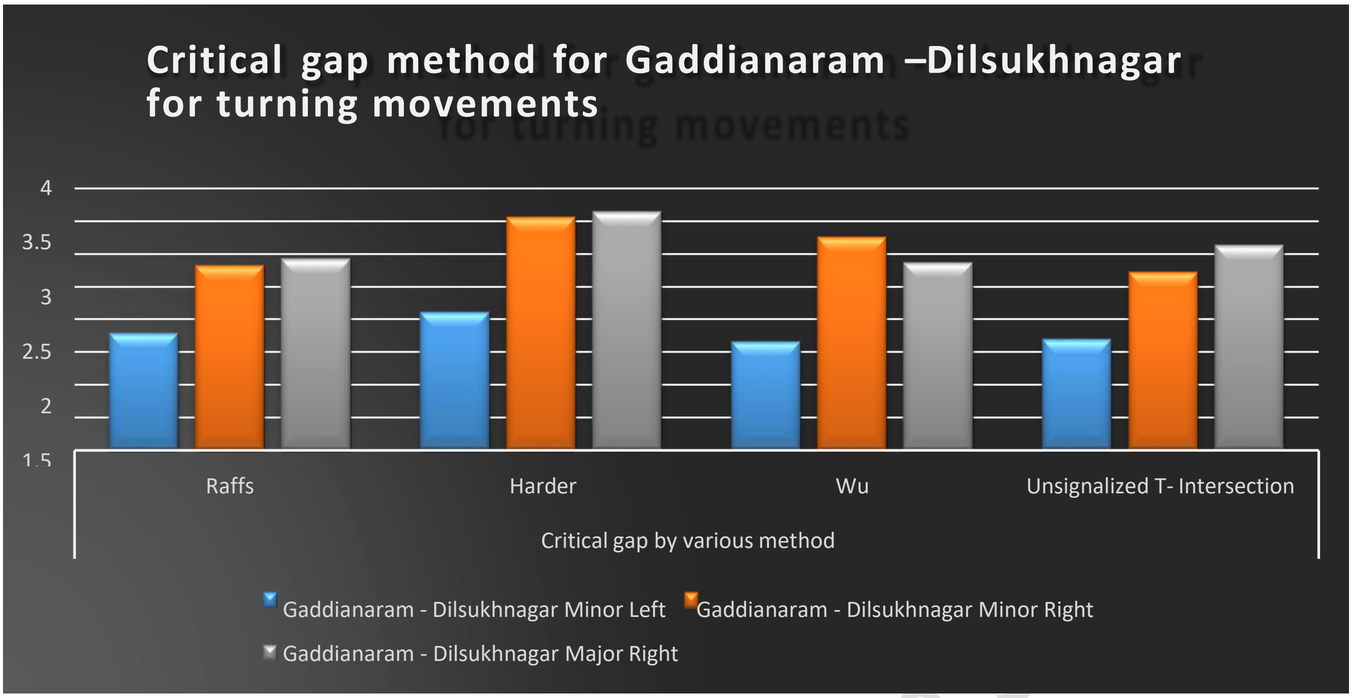


Figure 11 Critical gap on various methods for Gaddianaram – Dilsukhnagar intersection at turning movements

In the critical gap, the increasing turning movement is higher in the harder method the proposed unsignalized T- Intersection, and lower turning movements in Raffs methods and Wu methods.

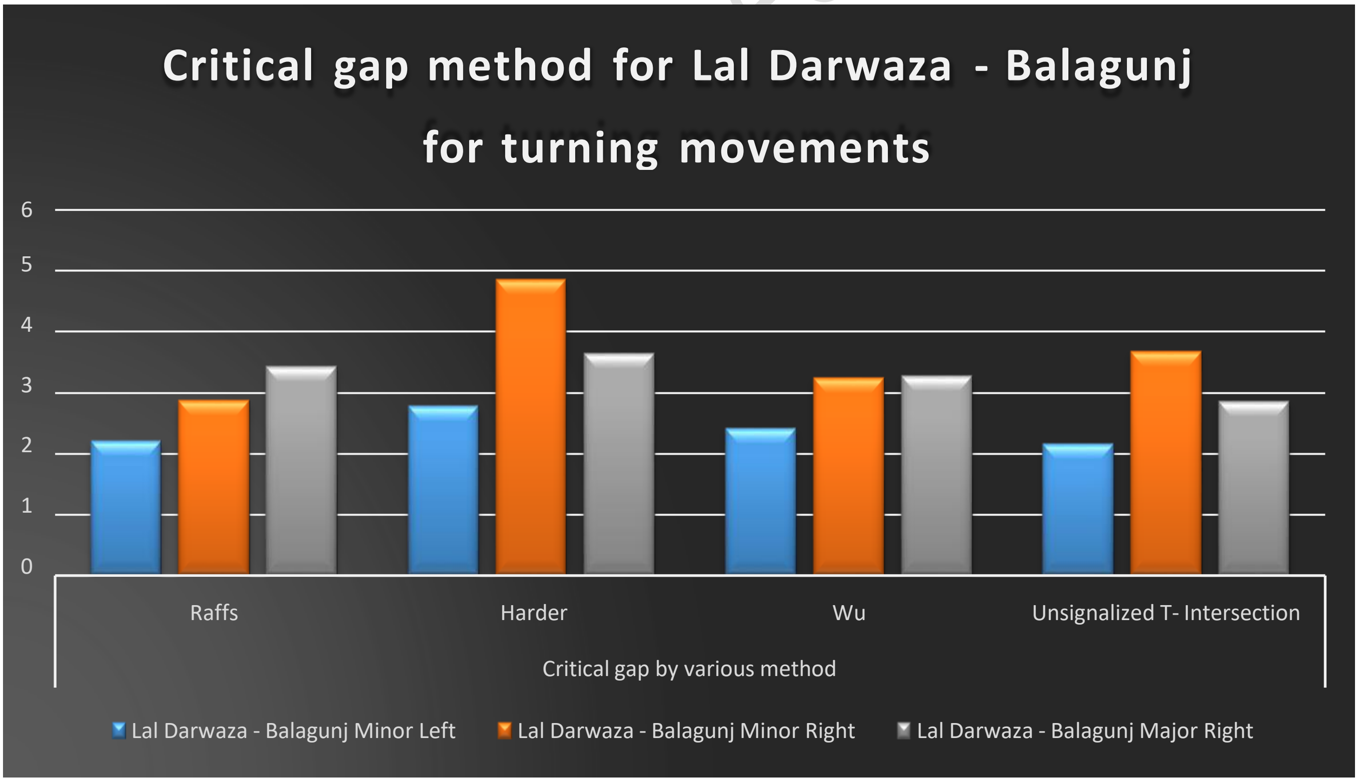


Figure 12 Critical gap on various methods for Lal Darwaza – Balagunj intersection at turning movements

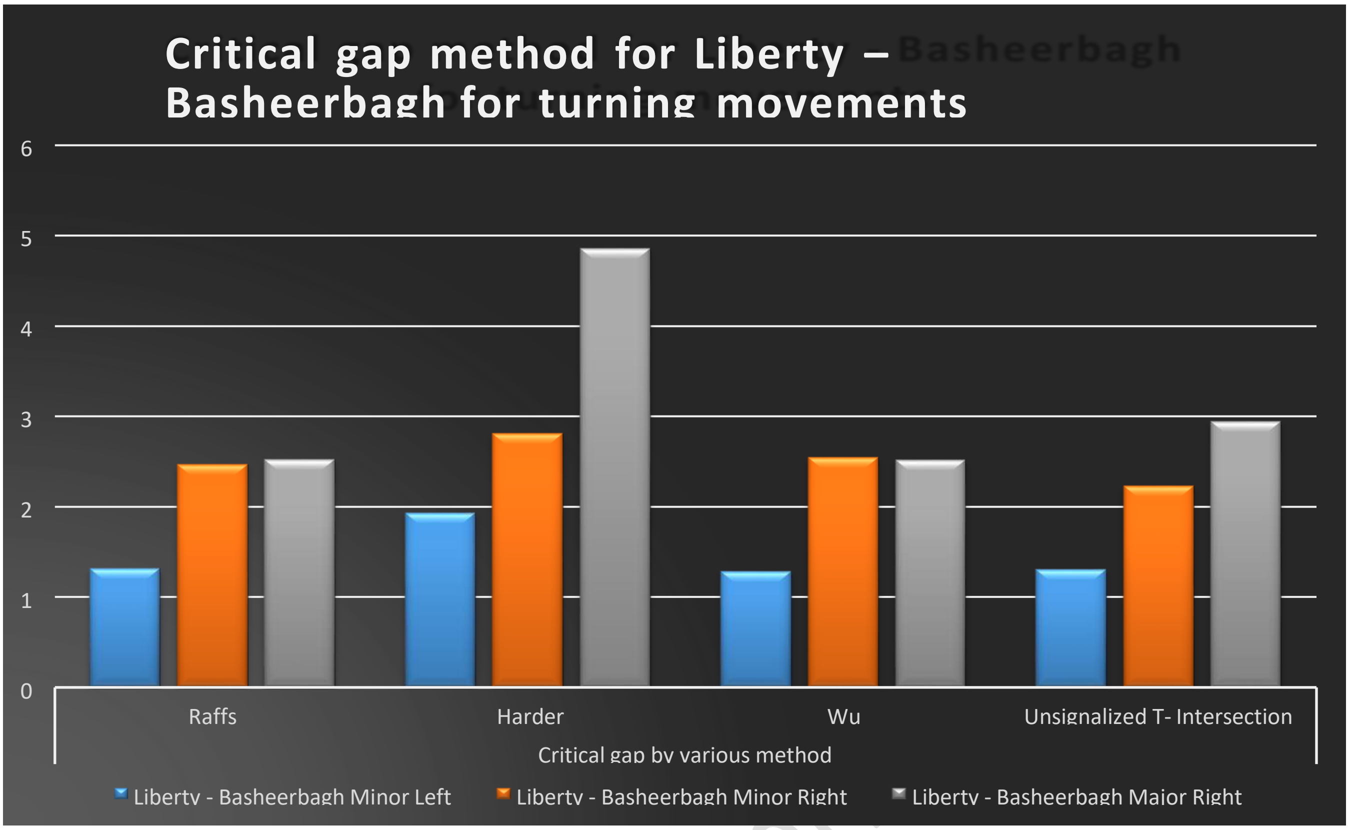


Figure 13 Critical gap on various methods for Liberty – Basheerbagh intersection at turning movements

In the critical gap, increasing capacities of vehicles in major and minor streams depends upon the geometric design, turning movements,and level of service.

6.2 CONCLUSIONS

Based on the results of this study, the following points were concluded.

1. The multiple linear regression model for the critical gap, follow-up time for Wu method, and Unsignalized Intersection R^2 value is 0.766 was considered as a goodness of fit under the level of significance 95%.
2. The multiple linear regression model for the critical gap, follow-up time for Wu method and Unsignalized Intersection R^2 value is 0.715 was considered as a goodness of fit under the level of significance 95%.
3. The multiple linear regression model for the critical gap, follow-up time for Wu method and Unsignalized Intersection R^2 value is 0.857 was considered as a goodness of fit under the level of significance 95%.
4. The results of the level of service for Major Right turn for turning and vehicular movement in various methods capacity for gaddianaram- dilsukhnagar, is 900-1000 veh/hr, Lal Darwaza – Balagunj is 728 veh/hr, Liberty – Basheerbagh is 1000 veh/hr during morning and evening peak hours.
5. The results of the level of service on various methods for queue length is less than 2 to 4 and the delay(Seconds) is 15-30 and level of service is applicable for various methods for unsignalized T- Intersection and proposed method for LOS B and LOS C.

Vol 13, Issue 03, MARCH /2022

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7. SCOPE FOR FUTURE WORK

The present study is limited to traffic for vehicular movement, capacity, queue length, delay, occupation time it has extended further for predicting accident analysis for pedestrians that occurred at unsignalized intersections under mixed traffic conditions.

The present study for capacity, gap acceptance, level of service for major and minor streams of turning movements at different locations of Intersection it can be further extended to stimulation techniques were implemented on the level of service for unsignalized- T intersection.

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