International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 04, April-2022

Research on Design of Traffic Signals At Non-Signalized Intersections in Lucknow City

Pranav Kumar Pal
M.tech Scholar, Transportation Engineering
Babu Banarasi Das University Lucknow, India

Kamal Nabh Tripathi
HOD-In Charge and Asst. Prof Department of Civil Engineering
Babu Banarasi Das University Lucknow, India

Abstract:- **In India growth of population plays an important role to increase the congestion at intersection because every person used separate vehicle for movement due to this reason traffic become out of control and create problem like accident, jam at the intersection. As we know every day many people die in road accidents due to lack of traffic control system because all intersections are not well signalized. So, it is not possible to control the movement of vehicles by traffic police due to increase in number of vehicles at intersection. Therefore, all intersections should be well signalized and traffic signals are specially designed for the emergency vehicles like Ambulance, Fire vehicles because emergency vehicles face delay at intersection when traffic at red light and it is very dangerous for our society. In this paper, Design of traffic signal is done with the help of the Indian Road Congress (IRC) and Webster's method. Traffic signal is better option for the effective transportation. Traffic signal systems are used to control the flow of vehicles with the help of traffic lights, where many roads meet together and make junction. Traffic volume studies are used to laid down mainly how many vehicles are moving on the road at a particular section during a particular time. Traffic signal is the best way of control vehicle movement at intersections without any accidents and conflicts.**

Keywords- Traffic signal, Traffic volume, Traffic light, PCU, IRC.

1.INTRODUCTION

Traffic signals are one of the most effective and flexible active control of traffic and is widely used in several cities world-wide. Traffic signals are used to control the flow vehicles passing through the intersection. The first traffic signal is reported to have been used in London as early as in 1868 and used two lamps red and green to control the traffic for night use at intersection. Traffic signals are placed at intersection and crossing to give the instruction to driver for further movement. Now days traffic signal has three lights Red, Amber and Green. Red light indicates to vehicles driver to stop, amber light indicates to vehicles driver to slow down the vehicle for stop. Green light indicates to driver for go. There are six types of traffic signal used- Traffic Control Signals, Fixed Time Signals, manually operated signals, Traffic Actuated Signals, Pedestrian Signals, Special Traffic Signals. A modern traffic signal containing of three basic subsystems: the signal lights in their housing, the supporting arms or poles, and the electric controller. The signal lights and housing are known as the signal light stack. A traffic signal system generally consists of three main components: a system control, field equipment, and communications. In the installation of traffic signals equipment is the first procured from the supplier then installed on intersection. This includes all poles, heads, push button facilities, detection and cabling. Traffic law follow is the most essential aspects of driving and can increase your safety as well as of the people around you.

2. REVIEW OF LITERATURE

Tariq Azizr, Er. Neeraj kumar (2021) The purpose of this paper is to design the fixed-timed traffic signal control system for the intersections and to assess performance of the over-time design system. It is compulsory for every vehicle to pass through a signalized intersections for achieve the best performance of intersection without any conflict. Traffic signals give instruction to only one lane users to move at a time while other lane users are stop and wait for their chance by the indication of traffic lights. Traffic signals are designed to control the flow of vehicles at intersection with the help of traffic lights and sensors and provide right way and also limit the stoppage time. Therefore, traffic signal installation is most important at each intersection for fluent flow of vehicle.

Madhan Kumar V, Renuka Prasad M (2020) The main purpose of this paper is to Signal Re- Design through IRC and Webster's Technology in Bangalore Metropolitan. There are two intersection needed Re-design traffic signal first one is G. Palya and second one is Jakkur due to more congestion and precaution. There are re- design traffic signal timings for the present vehicular volume count. For the present traffic IRC method is suitable to redesign of traffic signal timings whereas webster's method are not sufficient. IRC method of signal timings implement to avoid the major accidents on particular intersection.

Wei-Hsun Lee and Chi-Yi Chiu (**2020**) The main purpose of this paper is to design the smart traffic signal to reduce the traffic congestion and improve the public transport efficiency with the help of ITS applications. Smart traffic signal means, no any fault take place at the time of working of signals. In smart cities, traffic signals are also designed for the emergency vehicles like Ambulance, Fire Fighting vehicles. In United States, there were 3708 accidents involving emergency vehicles between 2004 and 2008. Emergency vehicle drivers also slow down the vehicle due to red light at intersection. Therefore, traffic signal design for emergency vehicles is most important for emergency purpose and also give the first priority to emergency vehicles to pass through the intersection without any conflict.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 04, April-2022

Raghavendra S. Sanganaikar et al, (2018) In this paper the design of traffic signal is done according to the IRC93 method of signal design by adopting maximum average passenger count unit (PCU) on the intersection in every direction. In this paper data have taken of the Kundalahalli junction, which is surrounded by 2 shopping malls, restaurants, corporate offices, etc. 3 bus-stand are also near this junction so, there are large amount of people and vehicles passing through kundalahalli junction. Classified traffic volume (cars, two wheelers, buses, trucks) are collected for a period of 12 hours (7:00-19:00) in order to have entire day data and to identify peak and non-peak hours. The data was collected for the interval of 15 minutes for 12 hours for 7 days. The 15 minutes data is then converted to 1 hour to find the traffic volume in PCU/ hour. The PCU values was converted successfully and the maximum 7 days average peak values was found to be 3582.

Vikram kumar and Neeraj kumar (2018) The purpose of this paper to traffic volume count study at Agrasen Chowk intersection, Yamuna Nagar. Traffic volume studies is done with the help of classification of vehicles like motorcycles, cars, jeep, buses, trucks. So, the traffic volumes are collected by manual counting. In this paper traffic signal for Agrasen chowk is designed by the various traffic surveys. For the scope of the project prediction is very important before the design, Annual Average Daily Traffic (AADT) is common flow utilized in geometric standards for highways, improvement of existing facilities. Average Daily Data is collected only for short time. The studies of Agrasen Chowk intersection conclude better understanding of the problems and finding of the effective measures to overcome all those problems.

Ishant Sharma and Dr. Pradeep K. Gupta (2015) The main purpose of this paper for provision of Automated Volume Based Traffic Signal System at Intersections. Automatic traffic signal prevents the fuel, time, speed up clearance and make intersection ecofriendly by reducing exhaust emissions. In this paper data is taken from Chandigarh city which is also facing the congestion problem at the intersection. In this paper the existing traffic signals are replaced with automatic traffic signals which sense the real time traffic and provide green time for the clear off traffic at the intersections. So, this paper conclude that existing traffic signals is replaced with the Automatic traffic signals for economic, reduce delay and ecofriendly purposes.

P. Saranya, Malliga Senthil (2015) The main purpose of this paper is to estimate the Cycle time of vehicle by Traffic controller with the help of Density Based adaptive Traffic Signal System. When a vehicle reached in the area of vehicular network then that vehicle is registered and achieve a certificate from the road Side Unit. Road side unit counts the number of vehicles and transmits that data to Traffic controller. And traffic controller generated the cycle time for this vehicle according to the vehicle density at intersection.

Lutfun Nahar Nipa, Md. Mohibul Islam (2015) The main Objective of this paper is to decrease the overall waiting time of traffic at intersection with the help of Intelligent Traffic Control System Based on Round Robin Scheduling Algorithm. This work is done with the help of microcontroller for cross the road junction which are so busy. This project is proposed to develop less traffic jam at intersection.

K. Vidhya, A. Bazila Banu (2014) The main purpose of this paper is designed to develop a Density Based Dynamic Traffic Signal System. Across the world large number of cities face the problem of traffic congestion. Now a days the time of traffic flow fixed lane by lane due to density of vehicles. Sensors are used for observing the movements of automobiles and calculate the number of vehicles on the lane. When the density of lane change then the timing of signal will also change. Traffic congestion increased due to major reason of high number of vehicles caused by population. In this paper density of vehicles measurement done in the signal with the help of open cv in the system.

Tang-Hsien Chang, Jen-Ting Lin (2000) The main purpose of this paper is designed to Optimal Signal Timing for an Oversaturated Intersection during congestion hour. In this paper two models are used for design first one is Discrete dynamic optimization model and other is Index model. Both proposed models are determined the optimal cycle length and optimal green time for the particular intersection.

3. DATA COLLECTION

The survey work has done at 5 Intersections namely-

- APTRON INTERSECTION AT DEVA ROAD, LUCKNOW
- NAVBASTA KALA INTERSECTION AT DEVA ROAD, LUCKNOW
- SHIVPURI INTERSECTION AT DEVA ROAD, LUCKNOW
- MACHALI MARKET INTERSECTION NEAR CHINHAT, LUCKNOW
- KENDRIYA VIDYALAYA INTERSECTION GOMTI NAGAR, LUCKNOW

The survey has been done for to give practical relation in the research work and this purpose the first thing I recorded the above intersections for 1-2 hours(12pm-2pm) with the help of camera. And extract the number of commercial vehicles & personal vehicles like Bus, Truck, Tractor, four-wheeler, three-wheeler, two-wheeler, Cycle and Animal drawn. After data extraction, I have changed the number of vehicles in PCU/hr.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 04, April-2022

3.1 APTRON INTERSECTION AT DEVA ROAD LUCKNOW

TYPE OF VEHICLE	NUMBER OF VEHICLE			PCU VALUE (PCU/hr.)		
	PHASE-1	PHASE-2	PHASE-3	PHASE-1	PHASE-2	PHASE-3
BIKE	696	358	536	348	179	268
CAR	319	80	245	319	80	245
AUTO	92	20	76	92	20	76
CYCLE	66	24	30	33	12	15
BUS	23	8	12	69	24	36
TRUCK	40	32	23	120	96	69
TRACTOR	13	18	7	39	54	21
TOTAL	**= 1249**	**= 540**	**= 929**	**=1020**	**= 465**	**= 730**

Table: 3.1 Volume of Vehicles at Intersection

3.2 SHIVPURI INTERSECTION AT DEVA ROAD LUCKNOW

TYPE OF VEHICLE	NUMBER OF VEHICLE			PCU VALUE (PCU/hr.)		
	PHASE-1	PHASE-2	PHASE-3	PHASE-1	PHASE-2	PHASE-3
BIKE	720	410	722	360	205	361
CAR	350	107	335	350	107	335
AUTO	90	30	65	90	30	65
CYCLE	44	54	56	22	27	28
BUS	16	8	12	48	24	36
TRUCK	11	------	9	33	------	27
TRACTOR	9	4	6	27	12	18
TOTAL	**= 1240**	**= 613**	**= 1205**	**= 930**	**= 405**	**= 870**

Table: 3.2 Volume of Vehicles at Intersection

3.3 NAVBASTA KALA INTERSECTION AT DEVA ROAD LUCKNOW

TYPE OF VEHICLE	NUMBER OF VEHICLE			PCU VALUE (PCU/hr.)		
	PHASE-1	PHASE-2	PHASE-3	PHASE-1	PHASE-2	PHASE-3
BIKE	756	360	734	378	180	367
CAR	330	137	320	330	137	320
AUTO	102	32	85	102	32	85
CYCLE	44	38	34	22	19	17
BUS	12	6	7	36	18	21
TRUCK	25	11	13	75	33	39
TRACTOR	9	--------	4	27	--------	12
TOTAL	**= 1278**	**= 584**	**= 1197**	**= 970 PCU/hr.**	**= 419 PCU/hr.**	**= 861 PCU/hr.**

Table: 3.3 Volume of Vehicles at Intersection

3.4 MACHALI MARKET INTERSECTION NEAR CHINHAT TIRAHA LUCKNOW

TYPE OF VEHICLE	NUMBER OF VEHICLE			PCU VALUE (PCU/hr.)		
	PHASE-1	PHASE-2	PHASE-3	PHASE-1	PHASE-2	PHASE-3
BIKE	640	420	366	320	210	183
CAR	250	145	135	250	145	135
AUTO	90	105	48	90	105	48
CYCLE	18	86	64	9	43	32
BUS	8	-------	4	24	-------	12
TRACTOR	4	-------	-------	12	--------	--------
TOTAL	**= 1010**	**= 756**	**=617**	**705 PCU/hr.**	**503 PCU/hr.**	**410 PCU/hr.**

Table: 3.4 Volume of Vehicles at Intersection

3.5 ANDHA MOD INTERSECTION NEAR KENDRIYA VIDYALAYA GOMTI NAGAR LUCKNOW

TYPE OF VEHICLE	NUMBER OF VEHICLE			PCU VALUE (PCU/hr.)		
	PHASE-1	PHASE-2	PHASE-3	PHASE-1	PHASE-2	PHASE-3
BIKE	730	420	570	365	210	285
CAR	300	185	325	300	185	325
AUTO	190	85	205	190	85	205
CYCLE	36	44	54	18	22	27
BUS	5	------	------	15	------	-------
TOTAL	**= 1261**	**= 734**	**= 1154**	**888 PCU/hr.**	**502 PCU/hr.**	**842 PCU/hr.**

Table: 3.5 Volume of Vehicles at Intersection

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 04, April-2022

4. METHODOLOGY

Traffic signals are the best way to control the congestion at intersections. Instructions are given to driver with the help of traffic lights (Red, yellow and green). Here, we use 2-methods for the design of traffic signal at non-signalized intersection.

1. Webster's method
2. IRC method

WEBSTER'S METHOD- Webster's method is a rational approach for signal design. The design is simple and is totally based on formula laid down by webster. In this method, the total cycle of the signal is determined which forms a total least delay occurring at signal.

IRC METHOD- The design of traffic signal according to IRC method by adopting maximum P.C.U on the intersection in each direction. Thus, traffic signal system should be introduced at the intersection with total cycle time of 140 seconds.

The signal design procedure involves six major steps. They include:

1. Phase Design
2. Determination of Amber Time and Clearance time
3. Determination of cycle length
4. Apportioning of Green Time
5. Pedestrian Crossing Requirements
6. Performance evaluation of the design obtained in the previous steps.

1. Design Procedure for webster's Method

- Normal Flow of Vehicles on Road, Denoted by q.
- Saturation Flow of Vehicles on Road, denoted by S.
- Critical Flow Ratio of Vehicles on Road, denoted by Y and **Y= q/S.**
- **Total Lost Time L= 2n+R** (n- number of Phase, R- All Red Time for Pedestrian, 12 Seconds.)
- Optimum Cycle time, **Co= 1.5L+5/1-Y (seconds)**
- Effective Green Time Per Cycle= **Co-L**
- Effective Green Time for **Phase 1= Y1/Y (Co-L)**
- Effective Green Time for **Phase 2= Y2/Y (Co-L)**
- Effective Green Time for **Phase 3= Y3/Y (Co-L)**

2. Design Procedure for Traffic Signal by IRC Method

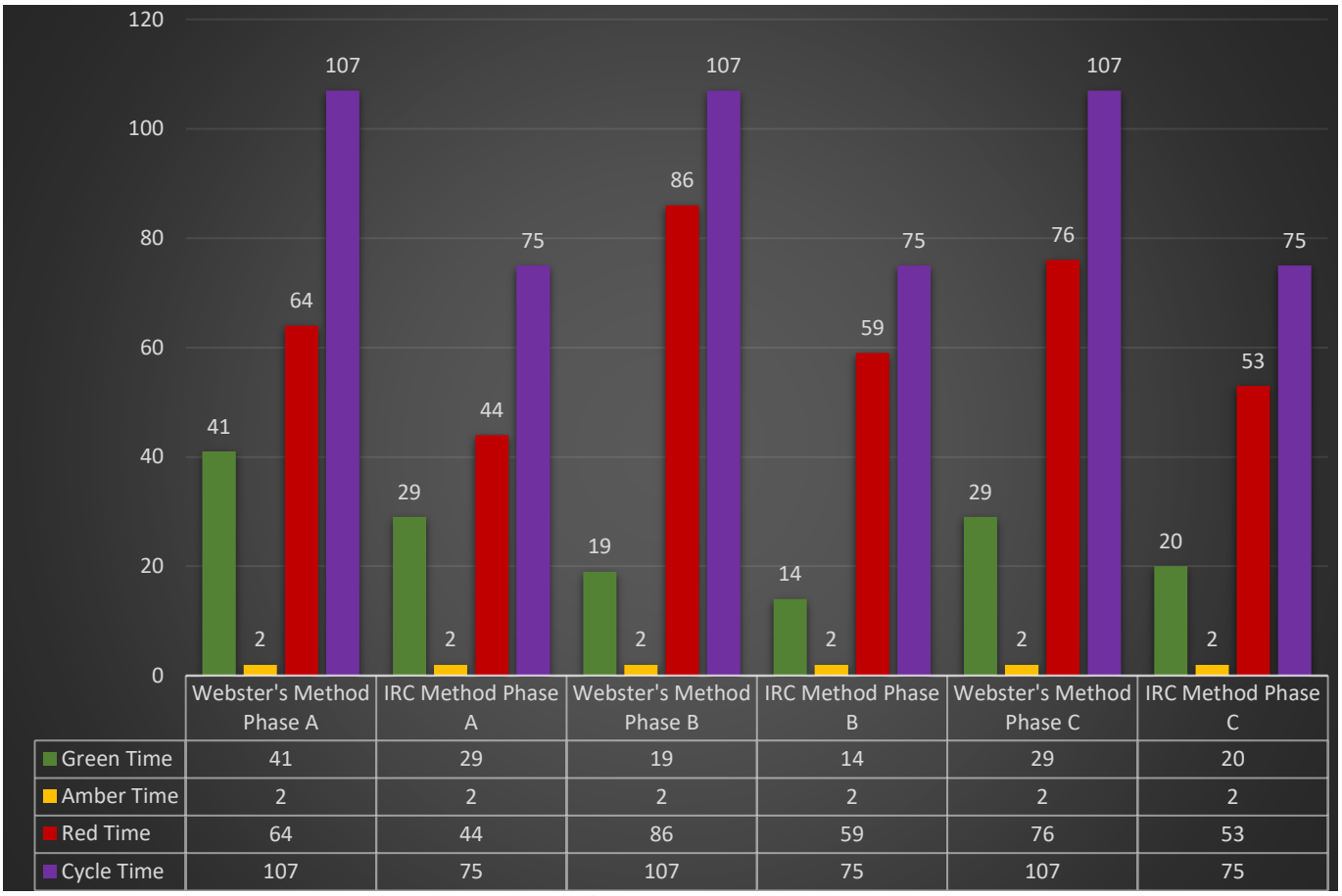
- Width of Road
- Pedestrian walking speed= 1.2 m/s.
- Step-1 Pedestrian Crossing Time= **(width of road/1.2) +7**
- Step-2 Minimum Green Time for Traffic= (**Pedestrian Crossing Time* Normal Flow) /Minimum Normal flow on Road.**
- Step-3 Revised Green Time for Traffic Signal = **(Adding 2.0 seconds each towards Clearance Amber and 2.0 seconds Inter green Period for each Phase)**
- Step-4 Check for optimum signal cycle by **Webster's Method-**

  Co= 1.5L+5/1-Y (seconds)

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 04, April-2022

5. RESULT

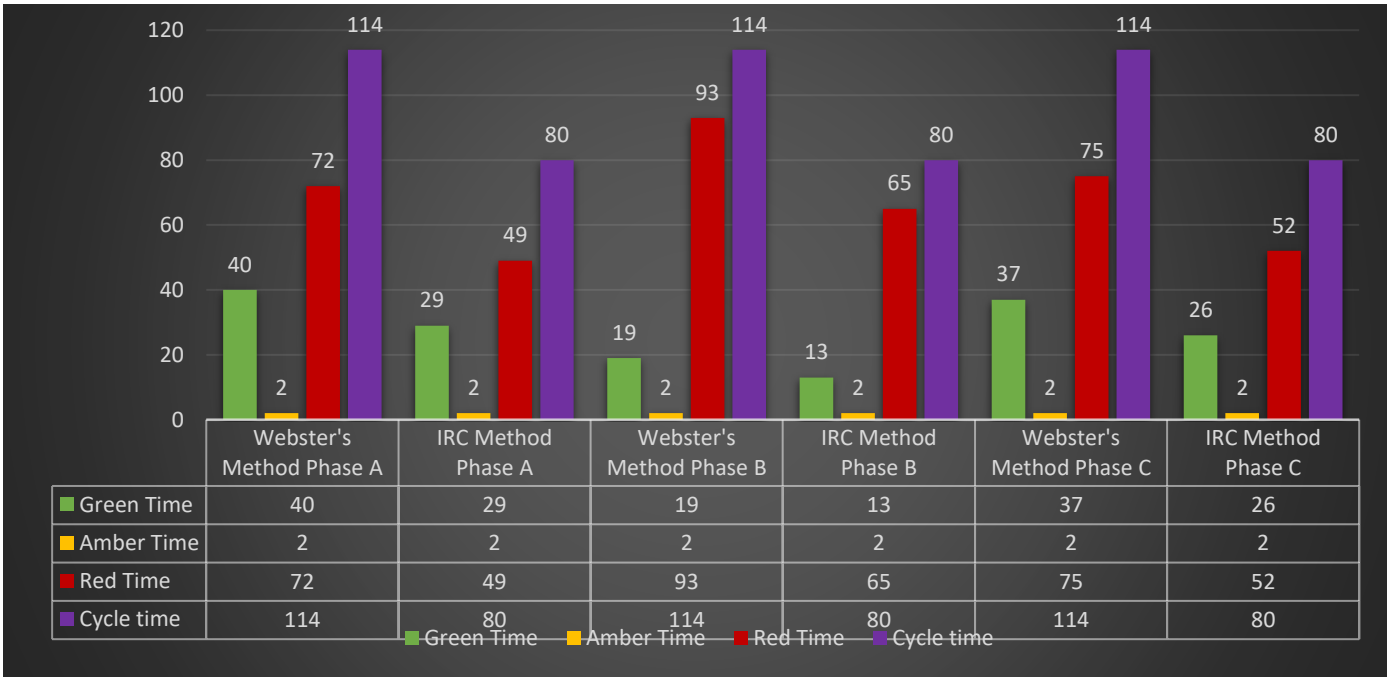
5.1 APTRON Intersection at Deva Road Lucknow



	Webster's Method Phase A	IRC Method Phase A	Webster's Method Phase B	IRC Method Phase B	Webster's Method Phase C	IRC Method Phase C
Green Time	41	29	19	14	29	20
Amber Time	2	2	2	2	2	2
Red Time	64	44	86	59	76	53
Cycle Time	107	75	107	75	107	75

5.1 Traffic Signal Timing in Seconds

5.2 SHIVPURI Intersection at Deva Road Lucknow

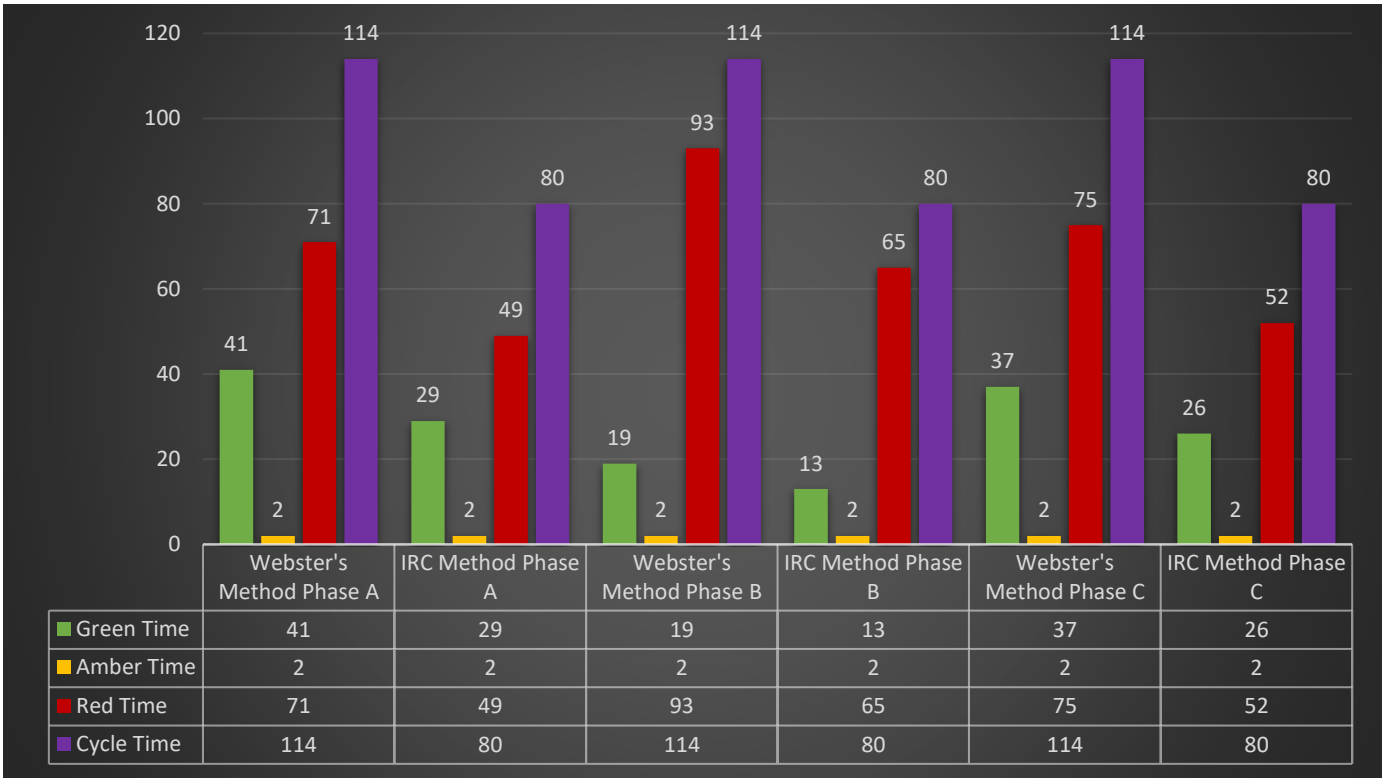


	Webster's Method Phase A	IRC Method Phase A	Webster's Method Phase B	IRC Method Phase B	Webster's Method Phase C	IRC Method Phase C
Green Time	40	29	19	13	37	26
Amber Time	2	2	2	2	2	2
Red Time	72	49	93	65	75	52
Cycle time	114	80	114	80	114	80

5.2 Traffic Signal Timing in Seconds

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 04, April-2022

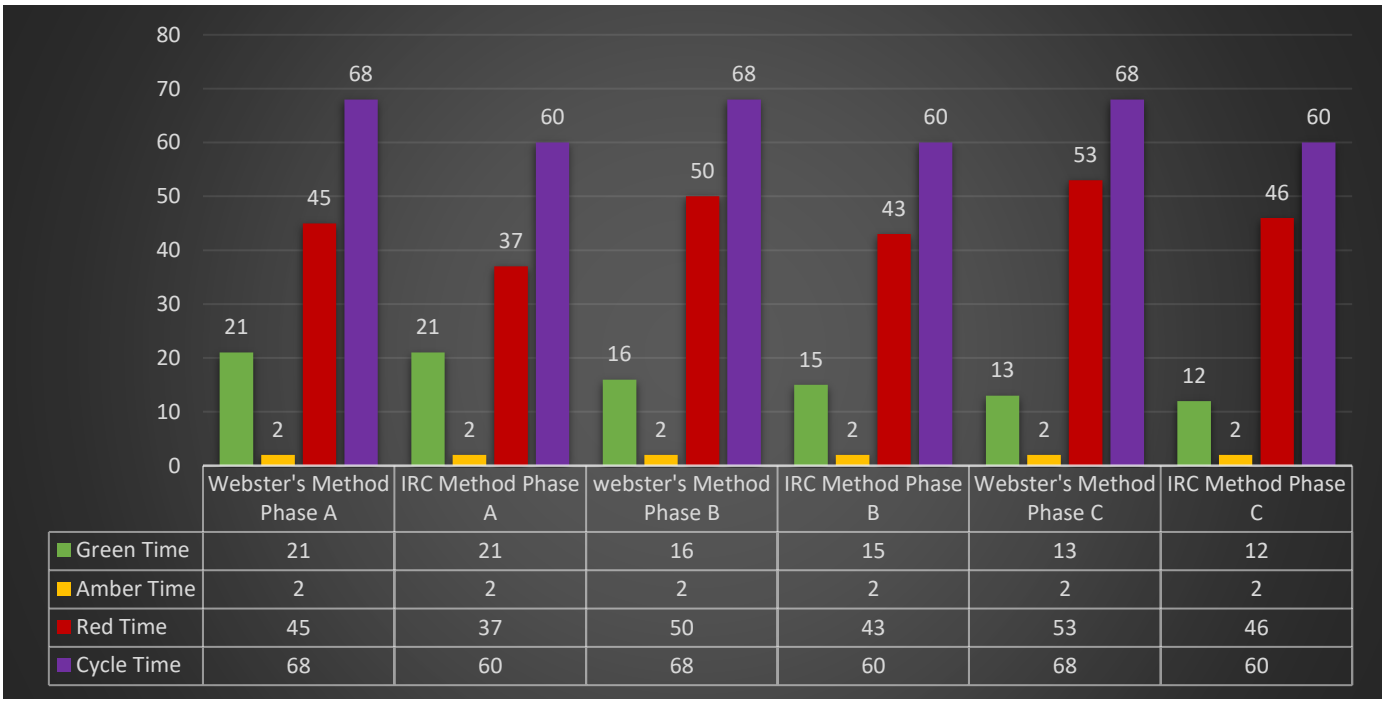
5.3 NAVBASTA KALA Intersection at Deva Road Lucknow



	Webster's Method Phase A	IRC Method Phase A	Webster's Method Phase B	IRC Method Phase B	Webster's Method Phase C	IRC Method Phase C
Green Time	41	29	19	13	37	26
Amber Time	2	2	2	2	2	2
Red Time	71	49	93	65	75	52
Cycle Time	114	80	114	80	114	80

5.3 Traffic Signal Timing in Seconds

5.4 MACHALI MARKET Intersection Near CHINHAT Lucknow

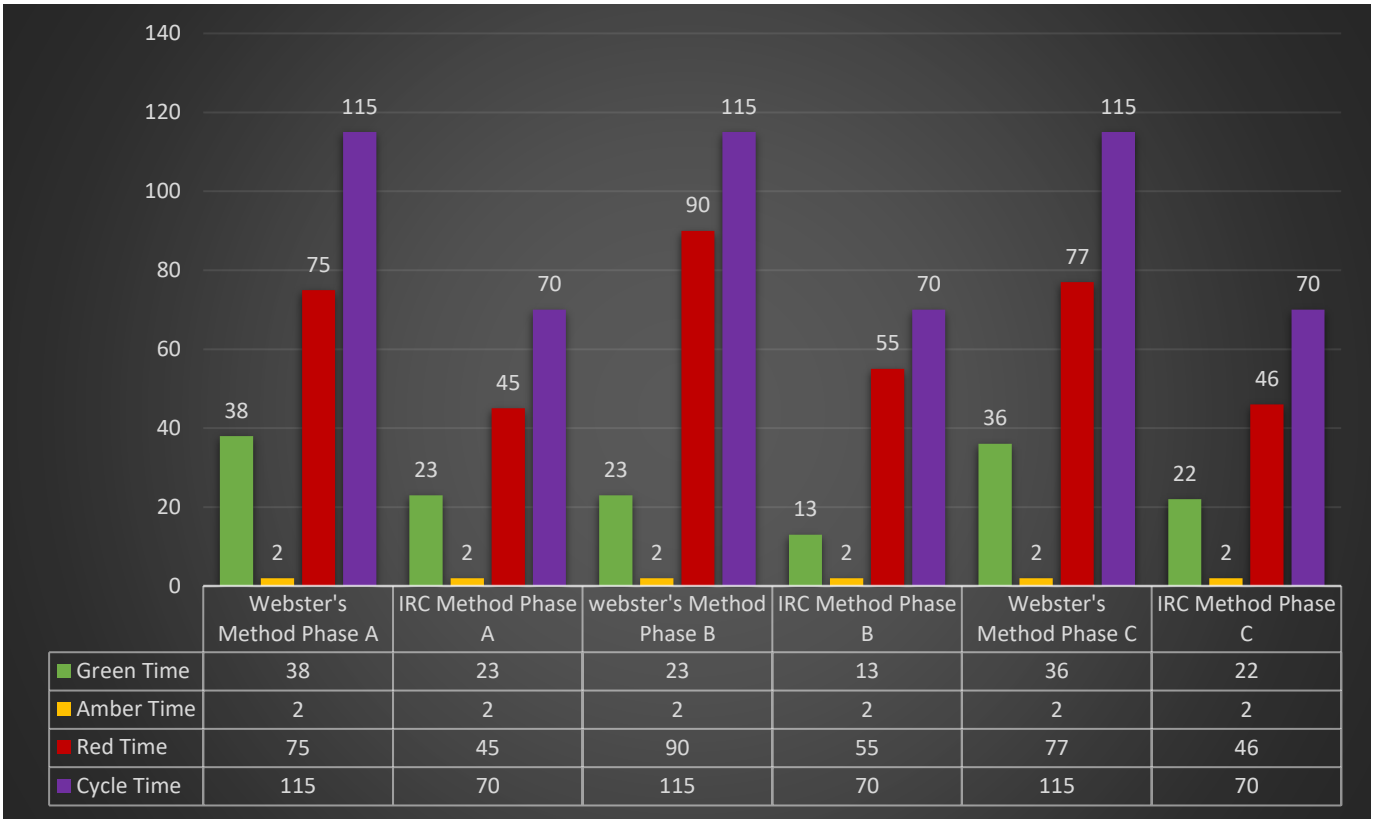


	Webster's Method Phase A	IRC Method Phase A	webster's Method Phase B	IRC Method Phase B	Webster's Method Phase C	IRC Method Phase C
Green Time	21	21	16	15	13	12
Amber Time	2	2	2	2	2	2
Red Time	45	37	50	43	53	46
Cycle Time	68	60	68	60	68	60

Table: 5.4 Traffic Signal Timing in Seconds

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 04, April-2022

ANDHA MOD Intersection Near KENDRIYA VIDYALAYA Gomti Nagar Lucknow



	Webster's Method Phase A	IRC Method Phase A	webster's Method Phase B	IRC Method Phase B	Webster's Method Phase C	IRC Method Phase C
Green Time	38	23	23	13	36	22
Amber Time	2	2	2	2	2	2
Red Time	75	45	90	55	77	46
Cycle Time	115	70	115	70	115	70

Table: 5.5 Traffic Signal Timing in Seconds

6. CONCLUSION

1. Installation of Traffic Signal at Intersection Reduce Congestion of Vehicles.
2. Installation of Traffic Signal at Intersection help for movement of Traffic securely without any Collision.
3. Traffic Signal reduce the number of accidents on roads like pedestrian accident and right- angle collision of Two Vehicles.
4. Installation of Traffic signal can increase the capacity of traffic handling at intersection without traffic police.
5. Traffic Lights are seen Easily in all Weather in day and night both.
6. Traffic Signal is Safe, efficient, accurate, and economical as compared to Traffic Police at Intersection.
7. Traffic Signal handled the heavy traffic at regular intervals without any interruption.
8. Main conclusion of my Research is that all Intersections are well signalized for better movement of vehicles at Intersections.
9. This project is proposed to developed less traffic jam at intersection.
10. As Traffic Congestion has reached its peak level, we have designed our project much more enhanced and smart infrastructure traffic network.

7. FUTURE SCOPE

Based on this study and findings, it is believed that the better analysis can be done on those intersections where traffic capacity is more.

1. This Project is useful in developing countries and this Project has a bright future as it is being used at every Intersection in Countries like London, Amerika, Russia, Japan, China.
2. Traffic signal help us to control flow of Vehicles without traffic Police.
3. The signals with three Traffic Lights Green, Amber and Red are shown at intersection. So, Driver of Vehicles does not have any type of difficulty.
4. The vehicle user directly seen the traffic signal Indication at intersection and cross the intersection without any conflict and delay.
5. This project will lead to increase in technological trends and this will help the people in many ways.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 04, April-2022

8. REFERENCES

[1] Tariq Azizr, Er. Neeraj kumar "TRAFFIC SIGNAL DESIGN" International Research Journal of Engineering and Technology. Volume:08 Issue:03 Mar2021.
[2] Wei-Hsun Lee and Chi-Yi Chiu "Design and Implementation of a Smart Traffic Signal Control System for Smart City Applications. 16 January 2020.
[3] Madhan kumar V, Renuka Prasad M "SIGNAL RE-DESIGN Through IRC and WEBSTER'S Technology International Research Journal of Science, Engineering and Technology. ISSN: 2395-4752, 2020.
[4] Raghavendra S. Sanganaikar et al., "Design of Traffic Signal at Kundahallli Junction Bengaluru Karnataka. International Journal of Scientific & Engineering Research, volume 9, Issue 6, June-2018.
[5] Vikram Kumar & Neeraj kumar "Study of Design Traffic Signal" International Research Journal of Engineering and Technology, Volume 5, Issue 12, Dec-2018.
[6] Ishant Sharma & Dr. Pradeep K. Gupta "Study of Automatic Traffic Signal System of Chandigarh" ISSN: 2277-9655, July 2015.
[7] P. Saranya & Malliga Senthil "Density Based Adaptive Traffic Signal System" January 2015.
[8] Lutfun Nahar Nipa, Md. Mohibul Islam "Intelligent Traffic control System Based on Round Robin Scheduling Algorithm" International Journal of Scientific and Research Publication, Volume 5, Issue 8, ISSN 2250-3153, August 2015.
[9] K. Vidhya, A. Bazila Banu "Design Based Traffic Signal System" International Journal of Innovative Research in Science, Engineering and Technology. Volume 3, Special Issue 3, March 2014.
[10] Tang-Hsien Chang, Jen-Ting Lin "Optimal Signal Timing for oversaturated Intersection" Transportation Research Part- B Methodological 34 (6): 471-491, August 2000.