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PERFORMANCE EVALUATION AND IMPROVEMENTS TO PALA CIVIL STATION JUNCTION

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Abstract – *Performance evaluation of an intersection is the need of the hour. We know the traffic performance at the intersection affects the whole road map. The increasing of traffic volume in the road especially in intersection has been arising many problems like road accidents, conflicts and congestions. Intersections are bottle neck to the whole system. These problems can solve by providing proper traffic control measures at the intersection for smooth and efficient movement of vehicles through the intersection. In this paper, analyzing and evaluating the performance of intersection at Pala Civil Station Junction, Kottayam, Kerala and also recommending possible enhancing measures, to reduce the number and severity of potential conflicts, on the basis of outcomes of traffic volume survey. The data's collected is used to identify, the normal flow of the road, and determine the influence of heavy vehicles or pedestrians on vehicular traffic volume. The collected vehicle data from the junction is converted into PCU units. Webster's method is used for manual signal designing.*

Key Words: **Congestion, Vehicular traffic, Traffic survey, Signal design, PCU**

1. INTRODUCTION

India is one of the fast developing countries. As we know, Transporting system and roadway are two major factors for the development of any country. The speed of mobilization along with intensity of traffic has been increasing day by day in Indian roads. Transporting network should be very efficient and flexible for minimizing economic loss due to fuel wastage and loss in valuable man hours, the functioning. Traffic volume studies were conducted to determine the number, movements, and classifications of roadway vehicles at location. These collected data can help identify critical flow time periods, determine the influence of large vehicles or pedestrians on vehicular traffic flow, or document traffic volume trends.

1.1 SCOPE AND OBJECTIVES

The main objective of this study is to elucidate traffic congestion Pala Civil Station, Kottayam, Kerala by proposing a suitable traffic improvement proposal for long term solution. This is done on the basis of the data and conclusions obtained from the traffic studies conducted on the considered area.

For achieving this, the objectives of the study are as follows:

(1) To find traffic improvement proposal for long term span. (2) To carry out surveys in the study area including traffic volume survey, topographic survey. (3) To analyze and evaluate intersections performance and recommend enhancing measures. (4) To establish relative importance of any route or road facility. (5) To minimize the number of potential conflicts and their severity. (6) To identify the various factors governing the traffic congestion. (7) To design the intersection on the basis of outcomes of traffic volume survey.

1.2 STUDY AREA

The Junction near Civil Station building pala connects 2 major bypasses and major roads. The 2 bypasses are (i) Pala-Thodupuzha Bypass (ii) Pala – Puliyanoor Bypass and the major roads are (i) Pala – Ramapurm - Koothattukulam road (ii) Kurishupally Junction road. There is no proper traffic signal present in this junction and the traffic congestion is handled manually by Traffic police. Many accidents are occurring in this junction due to poor traffic measures.

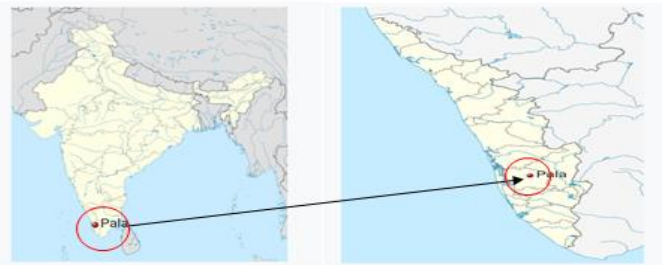


Figure -1: Study Area (Map)

1.3 NEED FOR THE STUDY

The study is aimed at analyzing the current traffic volume prevailing at the Pala Civil Station Junction. This is achieved through means of surveys which shall be conducted. Based on the results provided by the survey conducted ate site, adequate measures shall be adhered to which shall check for the performance of the junction along with Improvement measures which could be incorporated to ensure an efficient flow of traffic along the junction.

1.4 MAJOR PROBLEMS IN STUDY AREA

- Heavy volume of traffic during peak hours
- Formation of long queues during peak hours
- Lack of lane traffic

- Lack of traffic signs and lightings
- Absence of pedestrian crossings provisions
- Improper parking of vehicles

2. METHODOLOGY

2.1 DATA COLLECTION

Accident Data

Table -1: 5 year Accident data from Pala police station

YEAR	NUMBER OF ACCIDENTS OCCURED	NUMBER OF PERSONS INJURED	NUMBER OF PERSONS DIED
2016	8	10	0
2017	6	6	0
2018	13	15	0
2019	7	9	0
2020	6	7	0

Traffic Volume Study

Traffic volume is the number of vehicles crossing a section of a road at any selected period of time. Traffic volume studies were conducted at the intersection i.e. on 2 bypasses (i) Pala-Thodupuzha Bypass (ii) Pala – Puliyanoor Bypass and the major roads (i) Pala – Ramapurm - Koothattukulam road (ii) Kurishupally Junction road.

Survey Method

Traffic survey is the important part of any intersection design. Nowadays there are several methods of conducting traffic volume surveys. The most well-known technique involves employing personnel at the vantage points in the junction and manually noting down the traffic volume with respect to the various vehicle classifications include 2 wheeler, 4 wheeler, heavy, etc. in terms of Passenger Car Units (PCU). Here we recorded the intersection from a nearby tall building having a visibility to intersection & 4 roads.

PCU

Vehicles of different classes of are found to use the common road way facilities. To estimate the traffic flow the different vehicle classes they are converted, i.e. to one common standard vehicle unit. The common practice is to consider the passenger car as a standard vehicle unit to convert the other vehicle classes. The unit is called PCU.

Table -2: IRC: 70-1977 Recommended PCU Factors for Various Types of Vehicles in Urban Road

Sl. no	Vehicle type	Equivalent PCU factors Percentage composition of vehicle type in traffic stream	
	Fast vehicles	5%	10 %
1	Two wheelers – motor cycle, scooter, etc...	0.5	0.8
2	Passenger car, pick-up van	1	1
3	Auto-rickshaw	1.2	2
4	Light Commercial vehicle	1.4	2
5	Truck or bus	2.2	3.7
6	Agricultural Tractor – trailer	4	5

To establish the traffic flow characteristics at Pala Civil Station junction such as hourly variation, composition and peak hour flow at junction's studies were conducted. Hourly traffic volume by vehicle type and direction was added separately to determine the peak hour traffic at each point. The hourly variation of traffic is taken by manual methods. The data is collected for every direction of the junction.

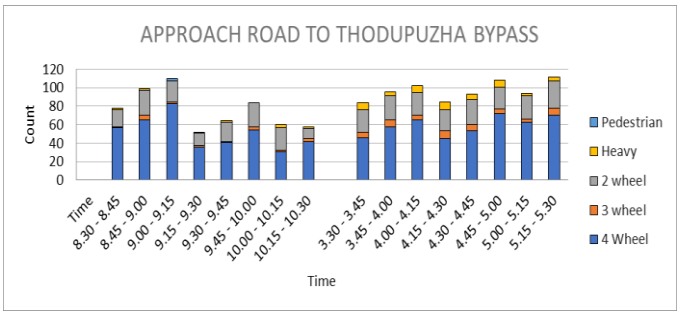


Chart -1: Vehicle Count - From Approach Road to Thodupuzha Bypass.

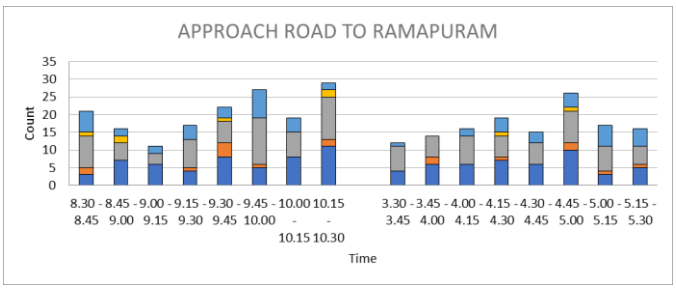


Chart -2: Vehicle Count - From Approach Road To Ramapuram

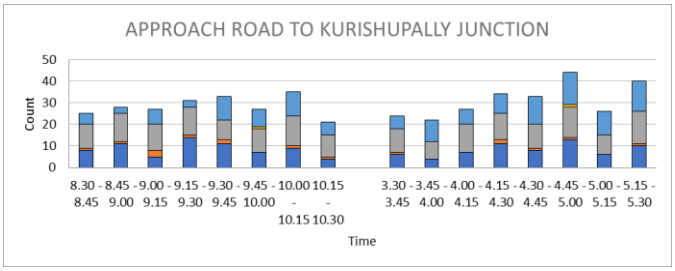


Chart -3: Vehicle Count - From Approach Road to Kurishupally Junction

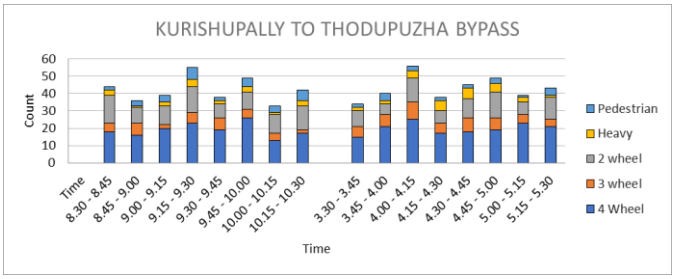


Chart -4: Vehicle Count - From Kurishupally Junction to Thodupuzha Bypass

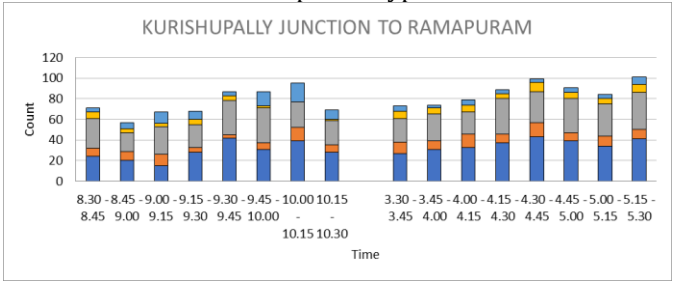


Chart -5: Vehicle Count - From Kurishupally Road to Ramapuram road

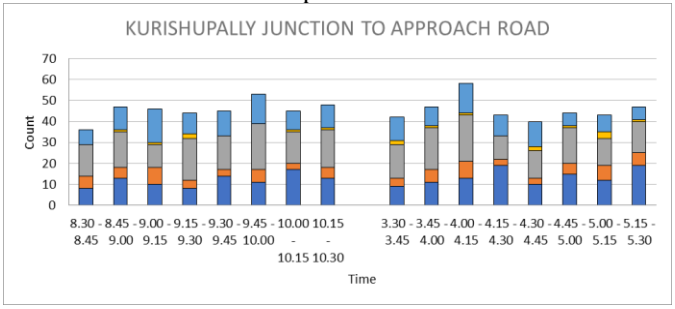


Chart -6: Vehicle Count - From Kurishupally Road to Approach Road

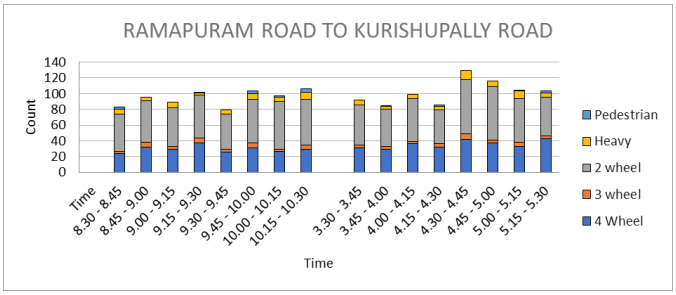


Chart -7: Vehicle Count - From Ramapuram road to Kurishupally Road

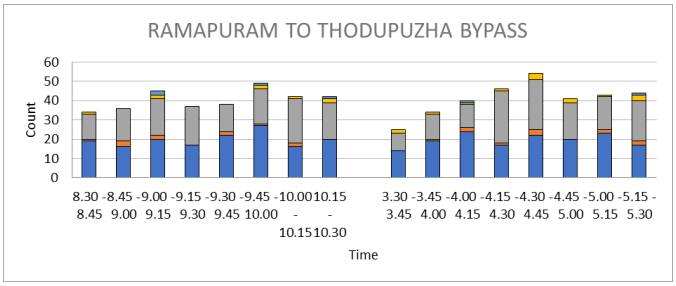


Chart -8: Vehicle Count - From Ramapuram road to Thodupuzha Bypass

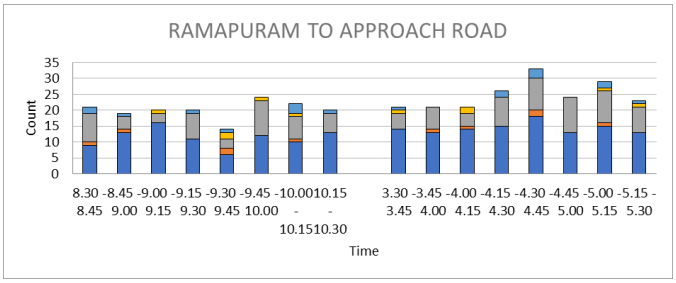


Chart -9: Vehicle Count - From Ramapuram road to Approach Road

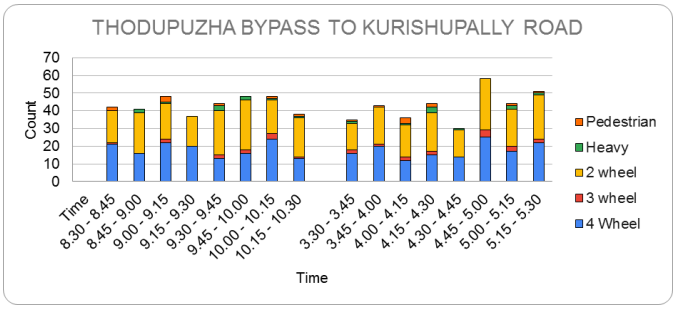


Chart -10: Vehicle Count - From Thodupuzha Bypass to Kurishupally Road

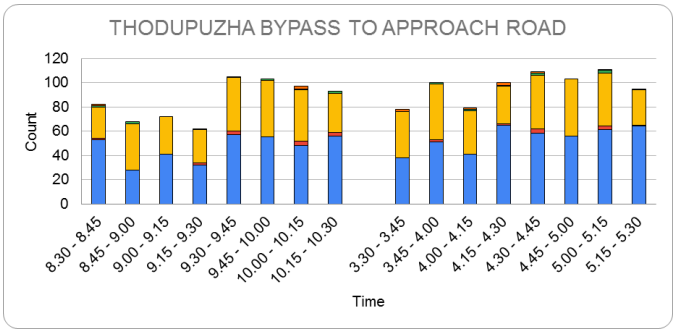


Chart -11: Vehicle Count - From Thodupuzha Bypass to Approach Road

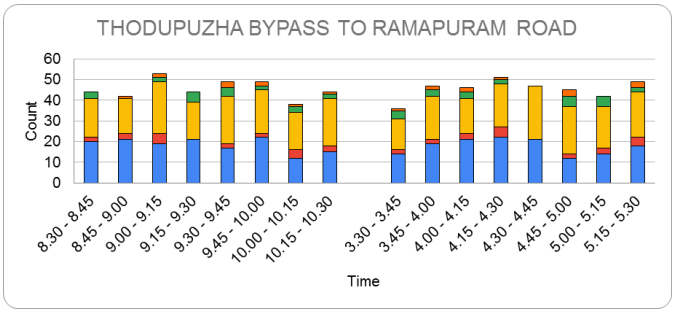


Chart -12: Vehicle Count - From Thodupuzha Bypass to Ramapuram road

2.2 DATA ANALYSIS

2.2.1. PCU PER HOUR

Table -3: PCU PER HOUR

ROAD	STRAIGHT	LEFT	RIGHT
APPROACH ROAD	405	94	134
KURISUPALLY JUNCTION	383	189	210
RAMAPURAM	434	175	105
THODUPUZHA	392	169	193

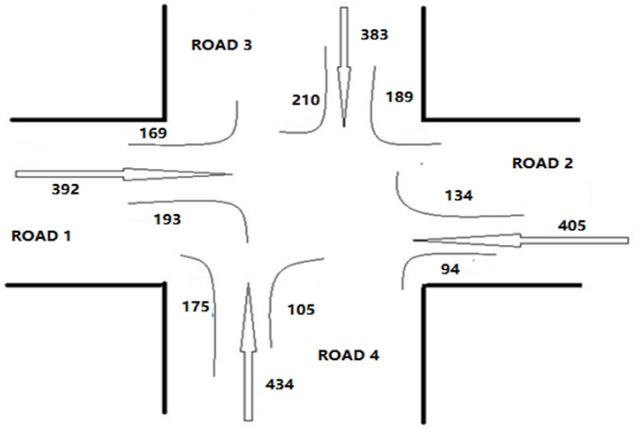


Fig -2: Vehicular Flow Diagram

2.2.2. WEBSTER'S METHOD

Webster's method is an analytical approach of determining the optimum signal cycle time C0 which is corresponding to minimum delay to all the vehicles at the approach roads of the junction or intersection. We conducted field study consists of determining the following set of values on each road approaching the intersection:

- q - Normal flow on each approach during the design hour
- S - Saturation flow, per unit time the normal flow values q1 and q2 on road 1 and road 2 are determined from field studies conducted during the design hours or the traffic during peak time of 15 minute's period. The saturation flow of vehicles is determined from careful field studies by counting the number of vehicles in the stream of compact flow during the green phases and the corresponding intervals precisely. If the data is not available the approximate value of saturation flow is estimated assuming 160 PCU per 0.3 m width of approach road.

Based on the selected values of normal flow, the ratio y1=q1/S1 and y2=q2/S2 are determined on the approach roads 1 and 2.In the case of mixed traffic, it is necessary to convert the different vehicle classes in terms of suitable of PCU values at signalized intersection; in case these are not available the may be determined separately. The normal flow of the traffic on the approach roads of the intersection may also be determined by conducting field's studies during off-peak hours to design different sets of signal timings during other periods of the day also, as required so as to provide different signal settings. The optimum signal cycle is given by the relation:

Co= 1.5L+5/1-Y

L= Total lost time per cycle sec=2n+R

n = is the number of phases

R=all red time or red-amber time;

Y=y1+y2

y1=q1/s1 and y2=q2/s2

Then, G1= y1/Y (Co-L), G2=y2/Y (Co-L)

Similar procedure is followed when there is more number of signal phases.

2.2.3. PHASE TIME CALCULATION

PHASE 1

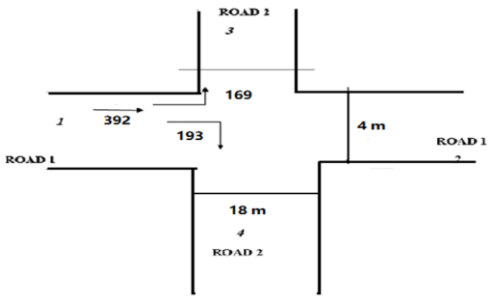


Fig -3: PHASE 1 Diagram

Width of the road, W1 = 11.5m W3=6m

W2 = 2m W4=9m

S = 525* W

S1= 525*11.5= 6037

S2= 525*2= 1050

S3= 525*6= 3150

S4= 525*9= 4725

Y= q/S

q1=392 q2=169q3=193

Therefore,

Y1 = q1/S1 = 392/6037= 0.064

Y2 =q2/S2 = 169/6037= 0.027

Y3 =q3/S3 = 193/6037= 0.031

Y1 = 0.064

PHASE 2

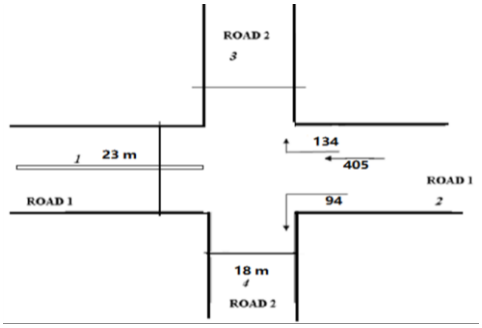


Fig -4: PHASE 2 Diagram

Y2 = 0.385

PHASE 3

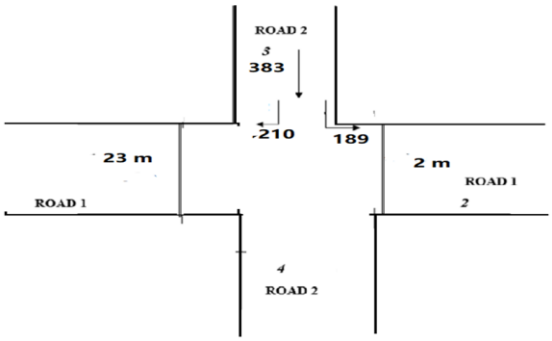


Fig -5: PHASE 3 Diagram

Y3 = 0.121

PHASE 4

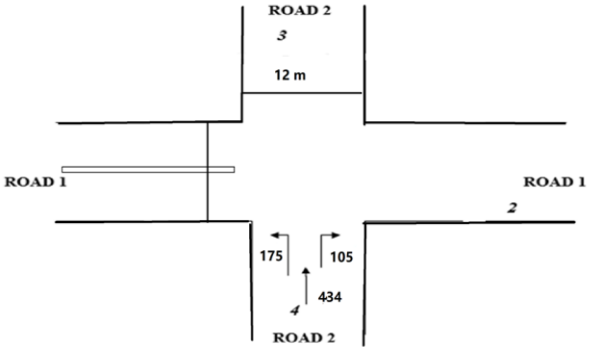


Fig -6: PHASE 4 Diagram

Y4 = 0.091

Y= Y1 + Y2 + Y3 + Y 4

= 0.064+0.385+0.125+0.091

=0.665

WEBSTER METHOD

By Webster method,

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

L =4n = 4*4 = 16

$$Co = \frac{(1.5*16)+5}{1-0.3132}$$

= 86.10

= 87 seconds

Effective green time = 87-16= 71 seconds

Green time for each phase

Green time for phase 1 = (Y1*effective green time) / Y

= (0.064*71)/0.665 = 7 sec

Green time for phase 2 = (Y2*effective green time) / Y

= (0.38*71)/0.665 = 41 sec

Green time for phase 3 = (Y3*effective green time) / Y

= (0.125*71)/0.665 = 14 sec

Green time for phase 4 = (Y4*effective green time) / Y

= (0.091*71)/0.665 = 8 sec

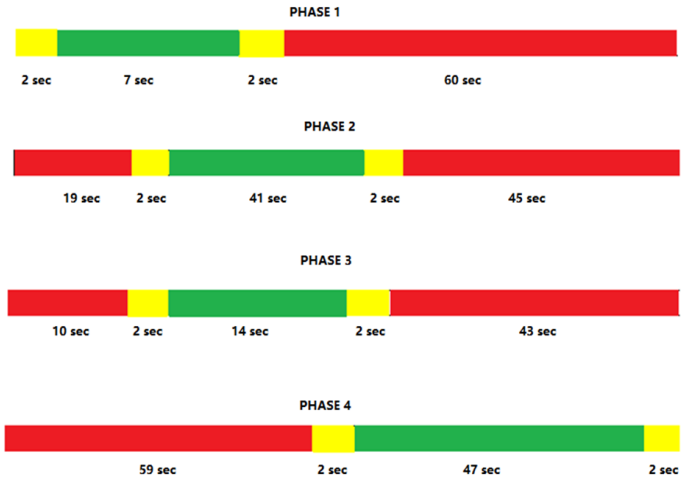
Red time, R1 =71-7=64 sec

Red time, R2 =71-41=30 sec

Red time, R3 =71-14=57 sec

Red time, R4 =71-8=63 sec

2.2.4. PHASE DIAGRAM



2.2.5. SUGGESTED ALTERNATIVES

- A flyover connecting PALA-THODUPUZHA BYPASS and PALA-PULIYANOOR BYPASS can decrease the amount of vehicle passing through the junction.
- Increasing width of the PALA-PULIYANOOR BYPASS approach road is a good way to reduce traffic congestion at the junction. Government should speed up the existing project to decrease the rate of congestion.
- If vehicles from Ramapuram direction are only allowed to turn left, ie to the Thodupuzha bypass, this redirection of vehicles can make a smooth flow and also reduce the potential conflicts at the junction.
- Providing adequate space for parking and pedestrians is also a major solution.

3. CONCLUSION

Traffic signal is a best cost effective way to control traffic at intersections where other control measures fail. The traffic signals operate by providing right of way to a certain set of movements in a cyclic order at the intersection. The design procedure discussed above includes phase design, determination of cycle time, computation of saturation flow, and green splitting. The main objective of this study was to determine the performance of the intersection near at Pala Civil Station, Kottayam, Kerala. The performance evaluation of the junction was done with the several parameters taken during the course of the study. Based on the performance evaluation which was done at the junction, several improvement measures were suggested, out of which the most feasible alternatives have been suggested as a further step in improving the existing traffic scenario. Owing to the growing financial capacities of the common man, more and more vehicles are coming out on the roads. And thus, there is a need to increase the transport and road infrastructure to cater to the needs and demands. This is an important step in the same direction. When properly designed, traffic signals and flyovers can increase the traffic handling capacity of an intersection, and when installed under conditions that justify its use, it will be a valuable device for improving the safety and efficiency of both pedestrian and vehicular flow.

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