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Traffic Signal Design at Mundur Junction

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ABSTRACT: The increase in number of vehicles leads to problems like congestion, road accidents, delay etc. These problems can now only be solved by providing an efficient traffic control at the intersections. Real time traffic signal control is a main part of the new urban traffic control systems, aimed at achieving the best utilization of the road network. The traffic signal is used for the control of different streams of vehicular and pedestrian traffic in most of the towns and cities. According to traffic signal, signal timing is most important which is used to decide cycle time for the vehicular traffic and also all red time for the safe movement of pedestrians. Traffic volume studies are to be made to determine the number, movement and classification of vehicles at the given location. The design is based on Webster's formula. This study focused on Mundur junction where, Cherppulasseri-Konghad-Palakkad road meets the NH-966 Highway. A Classified volume count survey has been carried out to monitor the traffic and the collected data was utilized for the design of traffic signals using Webster's formula at the three armed junction. The design is done as per IRC guidelines. The total cycle time obtained for morning session is 67.38 sec. and evening session is 58.65 sec.

KEYWORDS: Traffic Control, PCU, Traffic Survey.

I. INTRODUCTION

Traffic engineering is that branch of engineering which deals with the improvement of traffic performance of road networks and terminals. This is achieved by systematic traffic studies. The method includes planning and geometric design on one and regulation and control on the other. Traffic Engineering deals with the application of scientific principles, techniques and findings for safe, rapid, convenient and economic movement of people and goods.

The road traffic is composed of various categories of vehicular traffic and the pedestrian traffic. Each category of vehicular traffic has two components, the human element as the driver and his machine as vehicles. Traffic engineering has also to be recognized and governed by social and physical science. The profession of traffic engineering as known today has evolved with the advent of motor vehicle. Traffic engineering has now been recognized as an essential tool in the improvement of traffic.

Traffic signal is a usually used traffic operation manages system at urban roadway intersections. The capacity of urban road network mainly depends on the capacity of the traffic signals. Traffic Signals, also known as traffic lights, traffic lamps, signal lights, stop lights, and traffic control signals, are signalling device located at road intersections, pedestrian crossings, and other locations to control conflicting flows of traffic. Traffic signals are an important element of traffic control devices. The installation of traffic signals has a central role in calculating traffic hazards at the intersection. An intersection is the crucial point of conflicts and congestion in the road network.

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Mundur Junction (Y-Intersection) is one of the most important Major District Road (MDR) which connects to the areas of Cherppulasseri – Konghad – Palakkad Road meets the NH-966 Highway. We observed the problems like congestions, accidents etc. They are needed to be sort out and this is impossible by traffic lights which works on predefined programs as an alternative real time data. In adding to this, it also provides access to many educational institutes, shopping centres, restaurants, corporate offices, grain market, industrial areas etc.

Due to the above constraints, its reflection for research work has done so far. Finally at the study areas are required to provide a traffic signal to enable the efficient traffic control of traffic and also the faster clearing off the traffic from the intersection, designing & operating traffic system to achieve safe & efficient movement of persons & goods. Instead of building additional infrastructure, dynamic elements are also introduced into road traffic management.

1.1 Objectives

The objectives of the project are,

- To identify the various factors governing the traffic congestion.
- To improve the traffic flow by introducing traffic signal.

1.2 Scope of the Project

The scope of the study aims to,

- Provide safe and smooth running of vehicles
- Prevent accidents
- Give safe movements for pedestrians

II. LITERATURE SURVEY

Mundur junction is the road connecting Cherppulasseri-Konghad-Palakkad meets NH-966 Highway. Screen shot from Google map is shown below. There will be no orderly movement of traffic at the intersection. Also huge possibility for the traffic jams as well as accidents to occur. So there is a heavy requirement for traffic control for the orderly movement of traffic. To achieve this, a signalized procession is needed. As it is a three armed junction, a three phase traffic signal is to be provided.

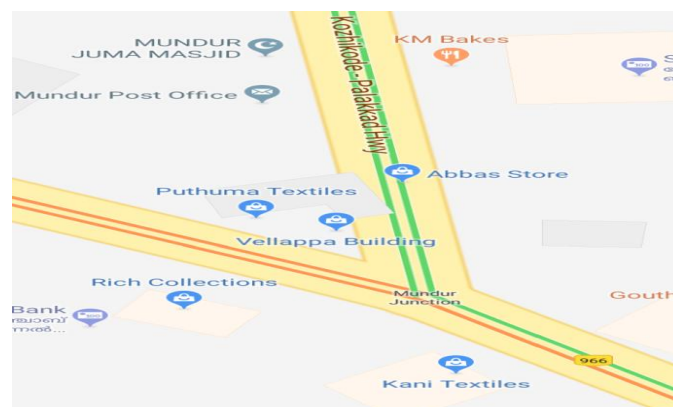


Fig. 1 Google image of the Mundur Intersection

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III. METHODOLOGY

3.1 Data Collection

In present study firstly, traffic field studies are used to have the traffic volume at Mundur Intersection which are used as input for the design of automatic traffic signals. Classified traffic volume (cars, two wheelers, buses, trucks etc.) are collected for a period of 12 hours (6:00-18:00) in order to have entire day data and to identify peak and non-peak hours. The data was collected for the interval of 1 hour for 12 hours for 7 days. The one hour data is to find the traffic volume in PCU/hr.

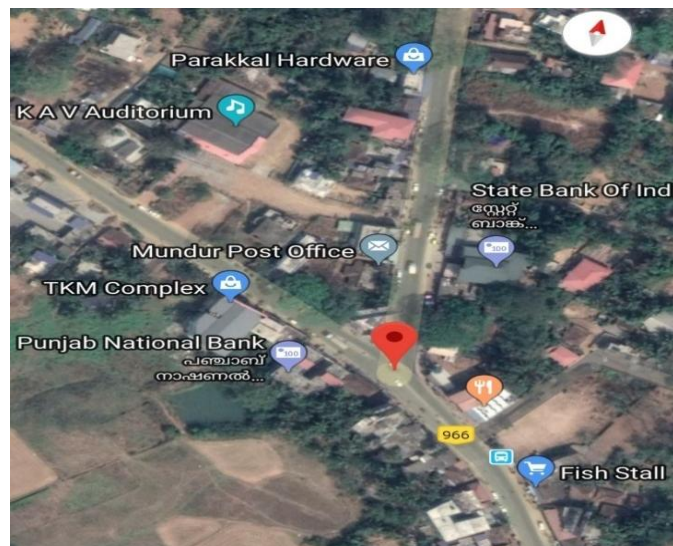


Fig.2 Satellite image of the Mundur Junction

3.2 Traffic Survey

A classified volume count survey had been carried out to monitor the traffic and the collected data was utilized for the design of traffic signals using Webster's formula. In this three armed intersection the count at each arm of the traffic entering the intersection was taken. Traffic volume count survey was taken through CCTV surveillance camera for one week from 06:00 am to 06:00 pm. The types and number of vehicles are sorted out for every 1 hour intervals and tabulated for each day. These tabulated values are used for determination of peak hour.

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Table 1 Sample data sheet of traffic count

Time	2W	3W	Car/Jeep/ Van	Tempo/Mi ni Lorry	Bus	Truck	Tractor	Bicycle	Animal Cart	Lorry	LCV	HCV	Total	PCU/hr.
6-7														
7-8														
8-9														
9-10														
10-11														
11-12														
12-13														
13-14														
14-15														
15-16														
16-17														
17-18														

As there are 6 directions at our junction, we were fixed the CCTV surveillance camera for the interval of 1 hr. for 12 hrs. for 7 days to find the traffic volume in PCU/hr.

- 1st direction is from Palakkad to Kozhikode
- 2nd direction is from Kozhikode to Palakkad
- 3rd direction is from Kozhikode to Konghad
- 4th direction is from Konghad to Kozhikode
- 5th direction is from Konghad to Palakkad
- 6th direction is from Palakkad to Konghad

3.3 Signal Design

Here three phase signal is designed. After obtaining the traffic volume data, the collected data is converted into PCU units. Normal flow was determined from the values obtained in traffic volume count survey in PCU. According to the width of the roads the saturation flow was determined from IRC SP – 41. Peak hour for morning and evening sessions were found out and optimum cycle length was determined. Webster’s method is a rational approach for signal design. The design is simple and is totally based on formulas laid down by Webster. By using this method total cycle of signal is determined. Red, green and amber times for three phases are designed. Webster’s method is given by,

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

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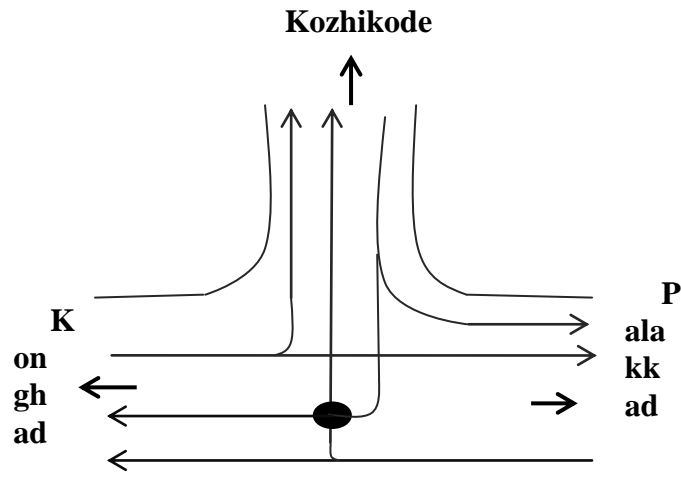


Fig. 3 Conflicting point at intersection

3.4 Phase Diagram

Three phase signals are adopted for this three armed intersection. The main objective of three phase design is to split the conflicting movement in an intersection into different phases, so that movements in a phase should have no conflicts. At Mundur junction, at any time in a day there is a large volume of traffic moving in all six directions. At this junction have three arms of equal size. The phase diagram of respective intersection is shown below.

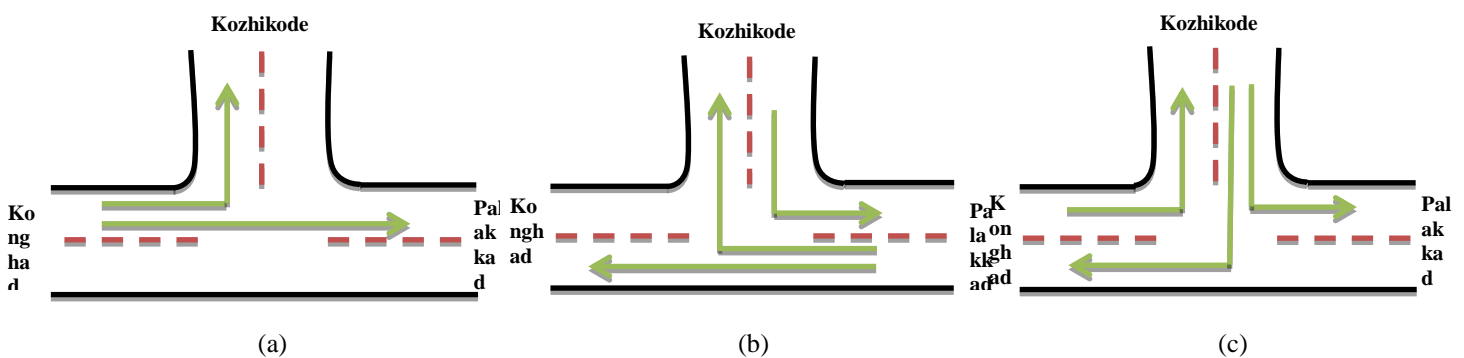


Fig. 4 Phase diagram. (a) Phase-1 (b) Phase-2 (c) Phase-3

IV. CALCULATION OF CYCLE LENGTH

Cycle time is the time taken by a signal to complete one full cycle of iteration, i.e. one complete rotation through all signal indications. It is denoted by C . The field work consist of finding (i) Saturation flow 'S' per unit time on each approach of the intersection and (ii) The normal flow 'q' on each approach during the design approach. The standard values for saturation flow 'S', according to Webster are given as in the below table.

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Table 2 Saturation flow for widths as per IRC SP-41

Width in Mtr.	PCU/ hr.
3.5	1890
3.5	1890
3.5	1890
5.5	2290
5.5	2290
3.5	1890

4.1 Calculation of cycle length for morning session

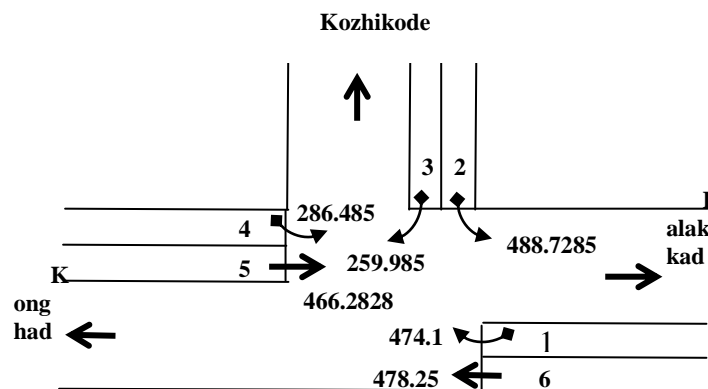


Fig. 5 PCU value for morning session from different streams

Normal Flows:

$$q_1 = 466.2428 \quad s_1 = 2290$$

$$q_2 = 474.1 \quad s_2 = 1890$$

$$q_3 = 259.985 \quad s_3 = 1890$$

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$$y1 = \frac{q1}{s1} = \frac{466.2428}{2290} = 0.20359$$

$$y2 = \frac{q2}{s2} = \frac{474.1}{1890} = 0.2508$$

$$y3 = \frac{q3}{s3} = \frac{259.985}{1890} = 0.1375$$

$$Y = y1 + y2 + y3 = 0.20359 + 0.2508 + 0.1375 = 0.59189$$

Cycle length according to Webster's method is calculated using the formula.

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

Where $L = 2n + R = (2 \times 3) + 9 = 15 \text{ sec.}$ $n = 3$

$$\text{i.e } Co = \frac{(1.5 \times 50) + 5}{1 - 0.59189} = 67.3837 \text{ sec.}$$

Calculation of Green time:

Phase-1

$$G1 = \frac{y1}{Y} (Co - L) = \frac{0.20359}{0.59189} (67.3837 - 15) = 18.01 \text{ sec.}$$

Phase-2

$$G2 = \frac{y2}{Y} (Co - L) = \frac{0.2508}{0.59189} (67.3837 - 15) = 22.1964 \text{ sec.} \approx 22.20 \text{ sec.}$$

Phase-3

$$G3 = \frac{y3}{Y} (Co - L) = \frac{0.1375}{0.59189} (67.3837 - 15) = 12.169 \text{ sec.} \approx 12.17 \text{ sec.}$$

Considering pedestrian time = 9 sec.

Amber time = 2 sec. & 6 sec. for 3 phases

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Total cycle length = 18.01 + 22.20 + 12.17 + 6 + 9 = 67.38sec.

Results:

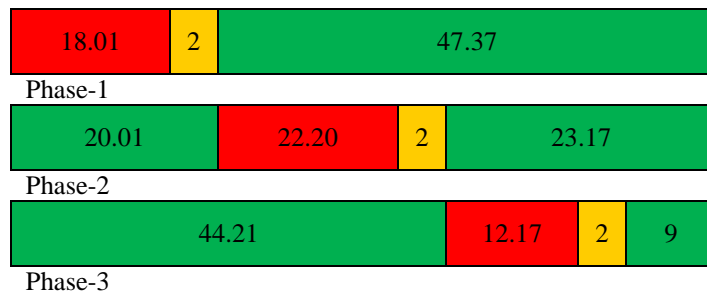


Fig. 6 Signal phase diagram for morning session

4.2 Calculation of cycle length for evening session

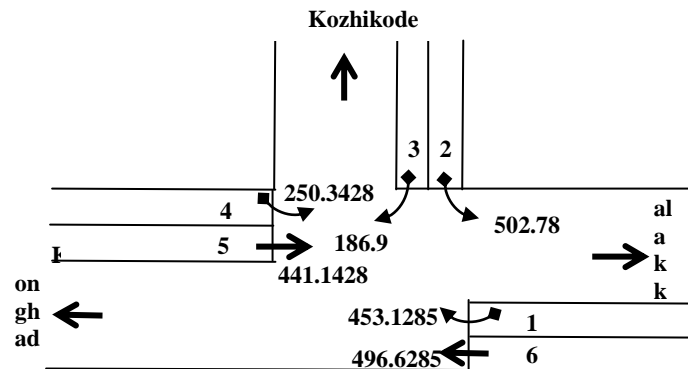


Fig.7 PCU value for evening session from different streams

Normal Flows:

$$q_1 = 441.1428 \quad s_1 = 2290$$

$$q_2 = 453.1285 \quad s_2 = 1890$$

$$q_3 = 186.9 \quad s_3 = 1890$$

$$y_1 = \frac{q_1}{s_1} = \frac{441.1428}{2290} = 0.1926$$

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$$y_2 = \frac{q_2}{s_2} = \frac{453.1285}{1890} = 0.2397$$

$$y_3 = \frac{q_3}{s_3} = \frac{186.9}{1890} = 0.0988$$

$$Y = y_1 + y_2 + y_3 = 0.1926 + 0.2397 + 0.0988 = 0.5311$$

Cycle length according to Webster's method is calculated using the formula.

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

Where $L = 2n + R = (2 \times 3) + 9 = 15 \text{ sec.}$ $n = 3$

$$\text{i.e. } C_o = \frac{(1.5 \times 50) + 5}{1 - 0.5311} = 58.647 \text{ sec.}$$

Calculation of Green time:

Phase-1

$$G_1 = \frac{y_1}{Y} (C_o - L) = \frac{0.1926}{0.5311} (58.647 - 15) = 15.8283 \text{ sec.} \approx 15.83 \text{ sec.}$$

Phase-2

$$G_2 = \frac{y_2}{Y} (C_o - L) = \frac{0.2397}{0.5311} (58.647 - 15) = 19.699 \text{ sec.} \approx 19.70 \text{ sec.}$$

Phase-3

$$G_3 = \frac{y_3}{Y} (C_o - L) = \frac{0.0988}{0.5311} (58.647 - 15) = 8.1196 \text{ sec.} \approx 8.12 \text{ sec.}$$

Considering pedestrian time = 9 sec.

Amber time = 2 sec. & 6 sec. for 3 phases

Total cycle length = $15.83 + 19.70 + 8.12 + 6 + 9 = 58.65 \text{ sec.}$

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Results:

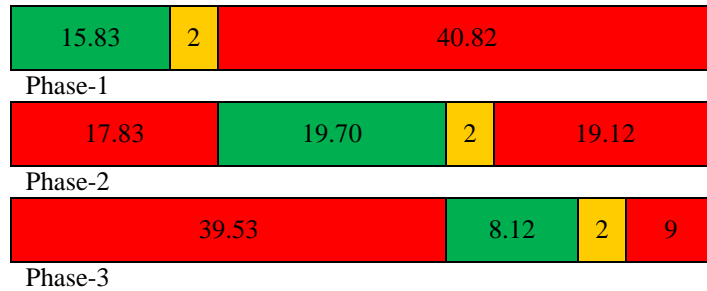


Fig. 8 Signal phase diagram for evening session

4.3 Positioning of the signal

The traffic signal shall be placed at the centre of the Y junction while facing the three arms.

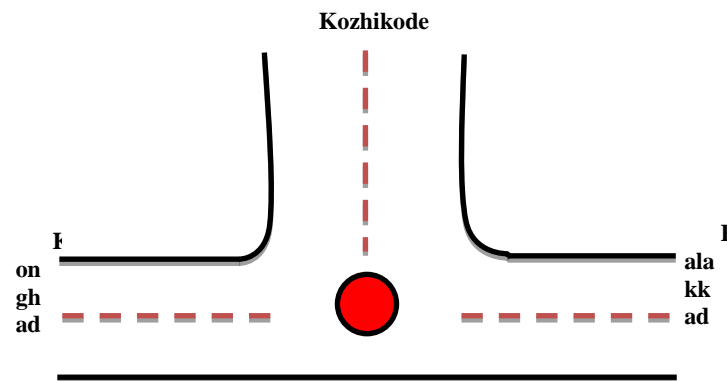


Fig.9 Positioning of the signal

V. SOLUTION

- Provide proper timing cycle to peak hour morning and evening time.
- Provide Auxiliary Lanes at road to reduce traffic congestion.
- Provide three phases of signal design for avoiding congestion.

VI. CONCLUSION

- Based on the calculations done on the PCU values obtained from the traffic survey, The Signal Cycle Length for Morning session is 67.38 seconds and for Evening session is 58.65 seconds.
- The effective green time obtained for Morning session is 18.01 sec for phase 1, 22.20 sec for phase 2 and 12.17 sec for phase 3. Similarly for Evening session effective green time obtained is 15.83 sec for phase 1, 19.70 sec for phase 2 and 8.12 sec for phase 3.

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- From the studies, the major accident causes is collision of vehicles at the intersections. These collisions can be avoided by providing proper signal design.
- The signal is designed as per IRC guidelines IRC:SP-106, IRC:SP-41 so that the signal can justify the proper movement of traffic.
- By providing signals there will be reduction in the conflicts. And also there will be an orderly movement of traffic in the proposed intersection.

APPENDIX



Fig.10Mundur Junction

REFERENCES

- [1] **Raghavendra S. Sanganaikar, Faisal Mehraj, Varun Leekha, Rimshi Khan, Ashiq Hussain** (2018), 'Design of traffic signal at Kundalahalli Junction Bengaluru Karnataka', *International Journal of Scientific and Engineering Research*, Volume 9, Issue 6, ISSN: 2229-5518.
- [2] **Vaishali Parmar, Ruchika Lalit** (2017), 'Traffic Signal and Junction Design; A Case study of Rajkot City' (2017), *International Journal of Engineering Research and Technology (IJERT)*, ISSN: 2278-0181, Volume 6, Issue 07.
- [3] **G.B. Ramesh Kumar, K.R. Priyarakshitha**, 'Traffic Congestion Survey at Chettiped Junction' (2018), *International Journal of Pure and Applied Mathematics*; Volume 119, No. 17, 1071-1078, ISSN: 1314-3395.
- [4] **Ramesh Surisetty, Soma N Sekhar**, 'Designing of a Traffic Signaling System at T-Intersection' (2017), *International Journal of Engineering Research and Application*, ISSN : 2248-9622, Volume 7, Issue 4, pp.82-86.
- [5] **B.Sudharsan Reddy, N. Venkata Hussain Reddy**, 'Signal Design for T-Intersection by using Webster's Method in Nandyal town, Kurmool district of Andhra Pradesh' (2016), *International Research Journal of Engineering and Technology (IRJET)*, Volume 03, Issue 04.
- [6] **R.Vinod Kumar and Pavithra M**, "Design of traffic signals at closely spaced intersection Tirupati" (2016), *International Journal of Advanced Research*, Volume 4, Issue 7, 1663 – 1670.
- [7] **Justo S.K Khanna**, "Highway Engineering" New Delhi: Khanna Publications, n.d.
- [8] **Kadiyali L.R.**, "Traffic Engineering and Transport Planning", New Delhi: Khanna Publications, n.d.
- [9] IRC code: IRC:106-1990
- [10] IRC code: IRC:SP-41