TRAFFIC SIGNAL DESIGNING FOR KARINGACHIRA JUNCTION

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Abstract: The increase in traffic volume can lead to problems like accidents, congestion, and conflicts .These problems can be reduced by providing an efficient traffic control signal at the intersections for efficient movement of vehicles. Traffic volume studies are conducted to determine the number, classification and movement of vehicles at the location. Classified vehicular count for 15 minute intervals was taken from the videos of the traffic flow at the intersection. Vehicular count was then converted to PCU .Webster's method was adopted for signal design. The total cycle time of the signal was obtained using Webster's method.

***Index Terms* – intersection, traffic signal design, PCU, vehicular volume, cycle length.**

I. INTRODUCTION

Roads congested with vehicles of all type create lots of problems including pollution, wastage of fuel and time. The traffic blocks have made travel a risky activity in cities. Traffic signals are one of the most restrictive forms of traffic control that can be used at an intersection. Traffic signals are automatic traffic control devices which could alternately direct the traffic to stop and proceed at intersections using red and green traffic light signals as per the pre-determined time settings. Implementing a traffic signal can lead to an orderly flow of traffic. This can also reduce the number of accidents.

II.LITERATURE SURVEY

Karingachira junction is a three legged intersection .The composition of this road is basically heterogeneous in nature. It is an urban area with several shops, market, commercial centers etc. Due to the high volume of traffic and improper alignment of roads, road becomes jam- packed .This can cause traffic congestion .so there is requirement for the regulation of traffic as well as orderly movement .The traffic congestion can be minimized by the implementation of a new signal.as it is a cross section of three roads, we can provide a three phase signal.

Fig 2.1 Kaingachira Junction

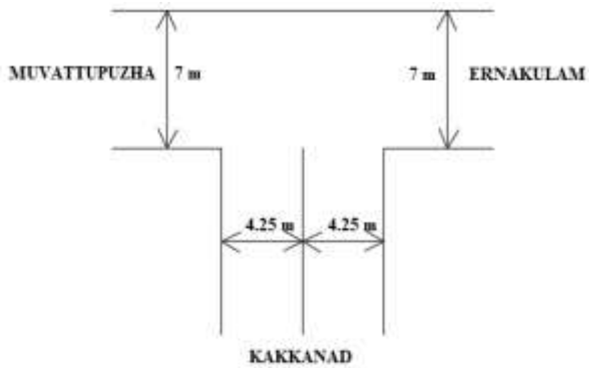

Fig 2.2: Road Width

III. DATA COLLECTION

In order to find out the volume of vehicles in the location and to find out the peak hour volume, a video of the traffic at Karingachira junction was recorded for 7:00 a.m.-12:00 p.m. in the morning and 4:00 p.m.-9:00 p.m. in the evening for all seven days of the week. Video was taken for 12:00 p.m. to 4:00 p.m.in the afternoon session for a day .

IV. TRAFFIC VOLUME STUDY

One of the fundamental measures of traffic is the volume of traffic using the road in a given interval of time when the traffic is composed of number of types of vehicles. Traffic volume is the number of vehicles crossing a section of road per unit time at any selected period of time. Traffic volume is used as a quantity measure of flow. The commonly used units are vehicles per day and vehicles per hour. A complete traffic volume study may include the classified volume study by recording the volume of various types and classes of traffic, the distribution by direction and turning movements and the distribution on different lanes per unit time.
The normal practice is to convert the flow into PCU by using certain equivalent factors. The flow is expressed in PCU per hour.
The Indian Road Congress (IRC 64-1990) has given set of tentative PCU values. They are as follows:-

Table 4.1 –PCU values as per IRC: 64-1990

Sl. No.	Vehicle Class	PCU Values
1	Passenger car, auto-rickshaw, pick-up-van	1.0
2	Bus, truck, agricultural tractor-trailer unit	3.0
3	Motor cycle, scooter and pedal cycle	0.5
4	Cycle rickshaw	1.5
5	Horse drawn vehicles	4.0
6	Small bullock cart and hand cart	6.0
7	Large bullock carts	8.0

V.METHODOLOGY

The steps involved in signal design are:

- The classified vehicular count for each approach was taken and tabulated.
- Vehicular volume was converted to PCU and the total PCU for each approach was calculated.
- Traffic warranting study was conducted.
- Out of the five warrants recommended by IRC: 93-1985, warrant 1, 2 were satisfied.
- Peak hour was obtained from the vehicular count data.
- The peak hours obtained were 8:00 a.m.-9:00 a.m. in the morning and 6.30 p.m.-7.30 p.m. in the evening.
- Knowing the width of the pavement, saturation flow for each approach was determined.
- Peak Hour Factor (PHF) for each directional flow was calculated.
- Total lost time, optimum cycle length, total effective green time and actual green time for all the three phases was calculated.

VI. PHASE DIAGRAM

Phase diagram is a diagram which groups the movements into phases and each phase is shown in a single block .In a three legged intersection, below three are the solutions for better flow of traffic in this area.Three phases were chosen because the provision of two phases will be insufficient and providing four phases is unnecessary.

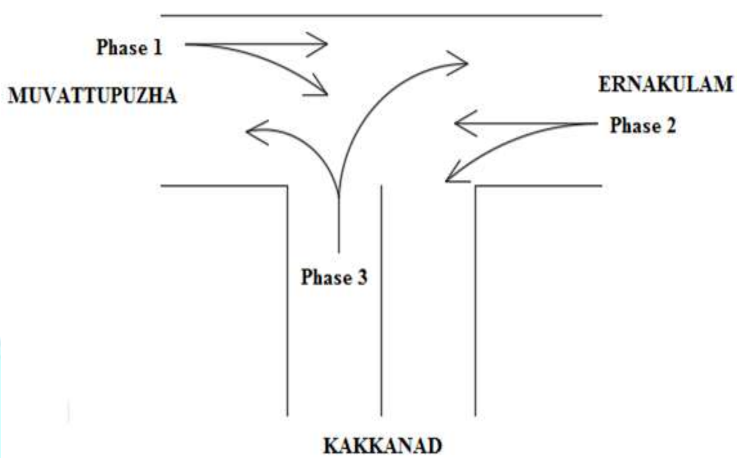

Fig 6.1 Phase Diagram

The three phases chosen were,
Phase - 1: Muvattupuzha to Ernakulam
Muvattupuzha to Kakkanad
Phase - 2: Ernakulam to Muvattupuzha
Ernakulam to Kakkanad
Phase -3: Kakkanad to Muvattupuzha
Kakkanad to Ernakulam

VII.CYCLE TIME

Cycle time is the time taken by a signal to complete one full cycle of iterations .The normal function of traffic lights requires more than slight control and coordination to ensure that traffic moves as smoothly and safely as possible and that pedestrians are protected when they cross the roads. Thus for signal designing the volume of traffic in different directions is obtained from volume count. Based on the volume count the signal is designed using Webster's method. In Webster's method the signal cycle time is determined.
The field work consists of:

- Finding the Saturation flow 'S' per unit time on each approach.
- Finding the normal flow 'q' on each approach .

The standard values for saturation flow,'S' as per IRC-93-1983 are given in the table below.

Table 7.1 Saturation flow values as per IRC: 93-1985

Width in m	3.0	3.5	4.0	4.5	5.0	5.5
PCU /hr	1850	1890	1950	2250	2250	2290

Saturation flow for road width 3.5 m = 1890 PCU / hr
Saturation flow for road width 4.25 m = 2100 PCU / hr

Based on the higher value of normal flow of 15 minute flow, the ratios $Y_1 = \frac{q1}{s1}$ and $Y_2 = \frac{q2}{s2}$ and $Y_3 = \frac{q3}{s3}$ are determined for the three phases.

The values used for signal designing should be converted to PCU.

Optimum cycle length, $C_0 = \frac{1.5\,L+5}{1-\sum_i^n Y}$

Effective green time per phase, $g_i = \frac{Y_i}{\sum_i^n Y}$ (Co - L)

L – Lost time, sec

$\sum_i^n Y$ -total critical volume/saturation flow

VIII. CALCULATION OF CYCLE LENGTH

The peak hour obtained was 8:00 a.m. to 9:00 a.m. in the morning and 6:30 p.m. to 7:30 p.m. in the evening.

8.1 MORNING SESSION

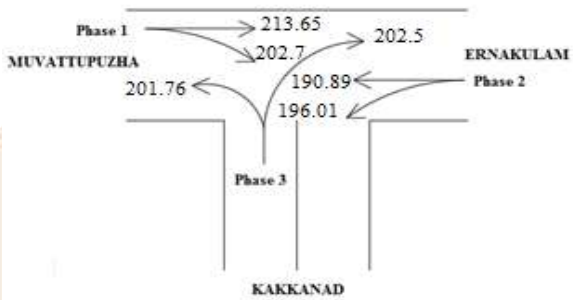

Fig 8.1.1 Phase Diagram Morning Session

Normal flows,

$q_1 = 354.725$, $q_2 = 245.01$, $q_3 = 354.39$

$y_1 = 354.725 / 1890 = 0.19$

$y_2 = 245.01 / 1890 = 0.13$

$y_3 = 354.39 / 2100 = 0.17$

Y= 0.19+0.13+0.17=0.49

- Provide amber time of 2 sec.
- All red period after each vehicular phase = 4 sec
- Minimum inter green period (I)=4 sec
- L = ∑ (I - a) +∑ l = (4-2)+(4-2)+(4-2)+2+2+2=12 seconds
-
- Optimum cycle length $C_O = \frac{1.5\,L+5}{1-y} = \frac{(1.5\times12)+5}{1-.49} \approx 50$ sec
- Effective green time per cycle $= C_O - L = 50-12 = 38$ sec
- Effective green time for phases can be calculated as $\frac{y\,Ns}{Y}$

For phase 1

- $g_1 = \frac{0.19}{0.49} \times 38 \approx 15$ sec

For phase 2

- $g_2 = \frac{0.13}{0.49} \times 38 \approx 10$ sec

For phase 3

- $g_3 = \frac{0.17}{0.49} \times 38 \approx 13$sec

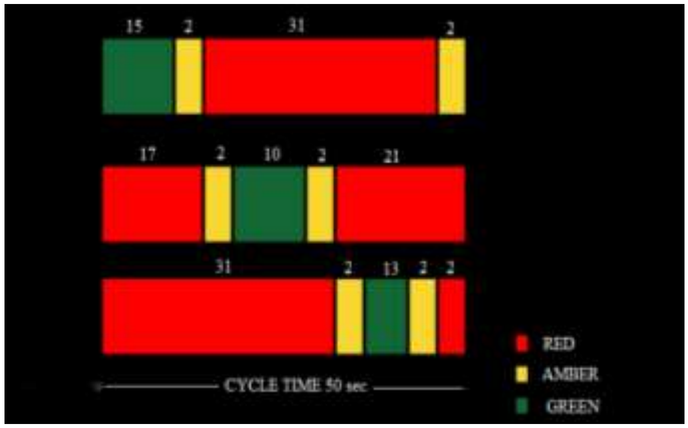

Fig 8.1.2 calculation of cycle length for morning session

8.2 EVENING SESSION

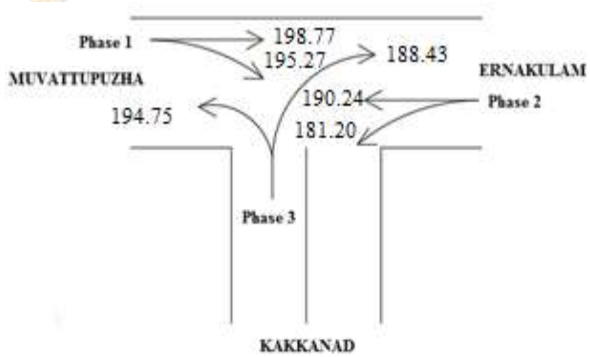

Fig 8.2.1 Phase Diagram Evening Session

Normal flows,

$q_1 = 341.72$, $q_2 = 317.1$, $q_3 = 328$

$y_1 = 341.72 / 1890 = 0.18$

$y_2 = 317.1 / 1890 = 0.16$

$y_3 = 328 / 2100 = 0.15$

$Y= 0.18+0.16+0.15 =0.49$

- Provide amber time of 2 sec.
- All red period after each vehicular phase = 4 sec
- Minimum inter green period (I)=4 sec
- $L = \sum (I - a) +\sum l = (4-2)+(4-2)+(4-2)+2+2+2=12$ seconds
-
- Optimum cycle length $C_O=\frac{1.5\,L+5}{1-y} = \frac{(1.5\times 12)+5}{1-.49} \approx 50$ sec
- Effective green time per cycle $=C_O - L = 50-12 = 38$ sec
- Effective green time for phases can be calculated as ,$\frac{y\,Ns}{Y}$

For phase 1

- $g_1= \frac{0.18}{0.49} \times 38 \approx 14$ sec

For phase 2

- $g_2= \frac{0.16}{0.49} \times 38 \approx 13$ sec

For phase 3

- $g_3= \frac{0.15}{0.49} \times 38 \approx 13$sec

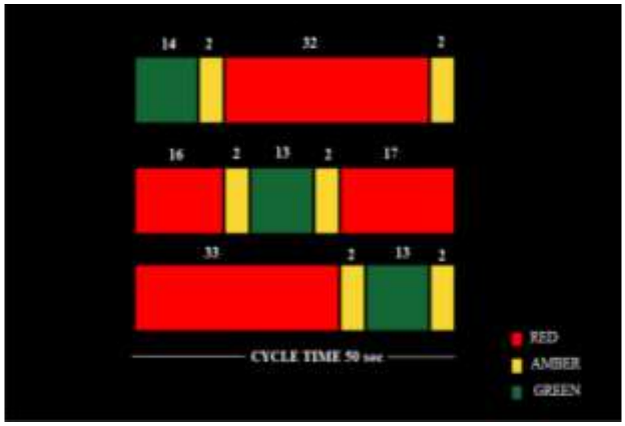

Fig 8.2.2 Calculation of cycle length for evening session

8.3 AFTERNOON SESSION

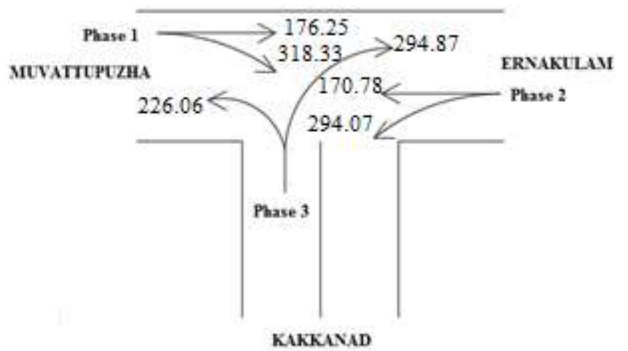

Fig 8.1.3 Phase Diagram Afternoon Session

Normal flows,

q_1 =318.32, q_2 = 294.07, q_3 = 294.87

y_1 = 318.32 / 1890 = 0.16

y_2 = 294.07 / 1890 = 0.15

y_3 = 294.87 / 2100 = 0.14

Y= 0.16+0.15+0.14=0.45

- Provide amber time of 2 sec.
- All red period after each vehicular phase = 4 sec
- Minimum inter green period (I)=4 sec
- $L = \sum (I - a) + \sum l = (4-2)+(4-2)+(4-2)+2+2+2=12$ seconds
-
- Optimum cycle length $C_O = \frac{1.5\,L+5}{1-y} = \frac{(1.5\times12)+5}{1-.45} \approx 45$ sec
- Effective green time per cycle $= C_O - L = 45-12 = 33$ sec
- Effective green time for phases can be calculated as $, \frac{y\,Ns}{Y}$

For phase 1

- $g_1 = \frac{0.16}{0.45} \times 33 \approx 12$ sec

For phase 2

- $g_2 = \frac{0.15}{0.45} \times 33 \approx 11$ sec

For phase 3

- $g_3 = \frac{0.14}{0.45} \times 33 \approx 12$sec

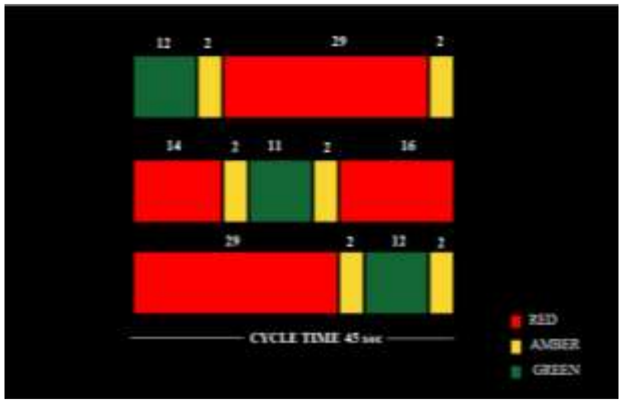

Fig 8.2.3 Calculation of cycle length for afternoon session

IX. CONCLUSION

Based on the calculations done on the PCU values obtained from traffic survey, the Signal Cycle Length for morning session is 50 seconds, for evening session is 50 seconds and for afternoon session is 45 seconds. By providing signals, there will be reduction in the conflicts. And also there will be an orderly movement of traffic in the un signalized intersection.

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