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Design of Traffic Signal by Using Different PCU Values for Amravati City

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ABSTRACT: The traffic volume is increasing day by day in cities like Amravati due to growth of industrialization and urbanization. In this project I have tried for redesigning of existing signals in Amravati city for heterogeneous traffic conditions to minimize delay. Traffic volume study has been done by videography method during peak hours. Signal designed is carried out by Webster method and as per IRC guidelines for different PCU and compared with existing signal timings. In this project the various terms related to traffic engineering has been studied such as survey of traffic volume, which is done by videography method and counted manually by playing videos on computer. The signal design for various intersections in Amravati city is carried out by Webster method and by using IRC guidelines for different PCU values and result is discussed.

KEYWORDS: Webster method, IRC guidelines, PCU Values, Videography.

I. INTRODUCTION

The traffic volume is increasing day by day in cities due to growth of industrialization and urbanization of cities. Thus, to manage the present traffic volume new methods were adopted to provide better, easy and safe movement of traffic. The traffic conflicts are major on intersections of two roads. Traffic signals are a way to control the traffic at the intersections of the cities and to avoid the conflicts of the vehicles at the intersection. Traffic signals also help the traffic to move with safety and easily, which tends to minimize the collisions between the vehicles at the intersection. Different classes of vehicles make use of the same roadway, particularly in developing countries like India: thus, the traffic streams consist of "mixed traffic flow". The vehicles of stream may be classified into different vehicle classes. They consists of: (1) fast moving vehicles such as (a) passenger cars, (b) buses, (c) trucks or heavy commercial vehicles (HCV), (d) light commercial vehicles (LCV), (e) auto rickshaws, (f) two wheeler automobiles (motor cycles and scooters) and (2) slow moving vehicles such as animal drawn vehicles like bullock carts, cycle rickshaws, pedal cycles, etc. Determination of volume of each vehicle class separately and finding the total volume is called 'Classified Traffic volume studies. In order to express the total traffic flow on a road per unit time it becomes necessary to convert the flow of different vehicle classes into one standard vehicle time, such as the 'Passenger car'. Therefore, each vehicle class is assigned and equivalency factor, called 'Passenger car unit' (PCU) in term of standard passenger car.

II. METHODOLOGY

WEBSTER'S METHOD OF TRAFFIC SIGNAL DESIGN

It has been found from studies that the average delay and the overall delay to the vehicles at the signalized intersection vary with the signal cycle length. The average delay per vehicle is a high when the cycle length is very less as a sizable proportion of vehicles may not get clear during the first cycle and may spillover to subsequent cycles.



As the signal time is increased, the average delay per vehicle decreases up to a certain minimum value and thereafter the delay starts increasing indicating that there is an optimum signal cycle time corresponding to least overall delay. The optimum cycle time depends on the geometric details of the intersection and the volume of traffic approaching the intersection from all the approach roads during the design hours. Webster’s method of traffic signal design is an analytical approach of determining the optimum signal cycle time, C_o corresponding to minimum total delay all the vehicles at the approach roads of the intersection. The field work consists of determining following two sets of values on each approach roads near the intersection:

1. The normal flow, q on each approach during the design hours and
2. The 'saturation flow', S per unit time.

The normal flow values q_1 and q_2 on roads 1 and 2 are determined from field studies conducted during the design hour or the traffic during peak 15 minutes period. The saturation flow of vehicles is determined from careful field studies by noting the number of vehicles in the stream of compact flow during the green phases and corresponding time intervals precisely. In the absence of data the approximate value of saturation flow is estimated assuming 160 PCU per 0.3 metres width of the approach road.

Based on the selected values of normal flow, the ratio $y_1 = q_1/s_1$ and $y_2 = q_2/s_2$ 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 PCU values at signalized intersection; in case these are not available they may be determined separately.

The normal flow of the traffic on the approach roads may also be determined by conducting field also, as required so as to provide different signal settings.

The optimum signal cycle is given by the relation: $C_o = 1.5L + 5 \frac{1-Y}{1-Y}$

Where,

L = total lost time per cycle sec = $2n + R$

N = is the no of phases

R = all red time or red amber time (all red time may also be provided for pedestrian crossing)

$$Y = y_1 + y_2$$

Here, $y_1 = q_1/s_1$, and $y_2 = q_2/s_2$

Then, $G_1 = (C_o - L)$ and $G_2 = (C_o - L)$

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

III. DATA COLLECTIONS

Table 1: PHASE A DATE: 07/04/2023

Sr. No.	Classification of vehicles	Duration	
		11.30 to 12.30 pm	6.00 to 7.00 pm
1	Two-Wheeler	1518	917
2	Three-Wheeler	208	78
3	Four-Wheeler	237	128
4	Bicycles	12	30
5	Bus /Trucks	69	9

Table 2: PHASE B DATE: 07/04/2023

Sr. No.	Classification of vehicles	Duration	
		11.30 to 12.30 pm	6.00 to 7.00 pm
1	Two-Wheeler	1426	1415
2	Three-Wheeler	158	106
3	Four-Wheeler	212	202
4	Bicycles	11	30
5	Bus /Trucks	61	4



Table 3: PHASE C DATE: 07/04/2023

Sr. No.	Classification of vehicles	Duration	
		11.30 to 12.30 pm	6.00 to 7.00 pm
1	Two-Wheeler	1293	1435
2	Three-Wheeler	166	126
3	Four-Wheeler	209	210
4	Bicycles	20	43
5	Bus /Trucks	80	7

IV. RESULTS AND DISCUSSION

Irwin Square by PCU values for urban road at Signalized intersection

No. of Phases N= 3
 All Red time or Red-Amber Time, R = 6

Table 4: data for Irwin square

Phase	q	w	s	Yn=q/n
A	974	7.8	4095	0.238
B	878	7.5	3938	0.223
C	895	7.5	3938	0.228

$$Y = 0.689$$

Where-

q-Nominal flow on road PCU per hour

w-Width of road in meter

s-Saturation flow y-Volume /Saturation flow for critical approach

$$\text{Total lost time, } L = 2N + R = 12 \text{ Sec}$$

$$\text{the optimum Signal cycle is given by relation, } C_0 = \frac{1.5 \times L + 5}{1 - Y} = 74 \text{ Sec}$$

$$\text{Green Phase Time for Phase A, } G_A = \frac{Y_a}{Y} (C_0 - L) = 22 \text{ sec}$$

$$\text{Green Phase Time for Phase B, } G_B = \frac{Y_b}{Y} (C_0 - L) = 21 \text{ sec}$$

$$\text{Green Phase Time for Phase C, } G_C = \frac{Y_c}{Y} (C_0 - L) = 21 \text{ sec}$$

Table 5: result for Irwin square

Phase	Green Phase Time (sec)	Amber Phase Time (sec)	Red Phase Time (sec)	Cycle Time C ₀ (sec)
A	22	4	48	74
B	21	4	49	74
C	21	4	49	74

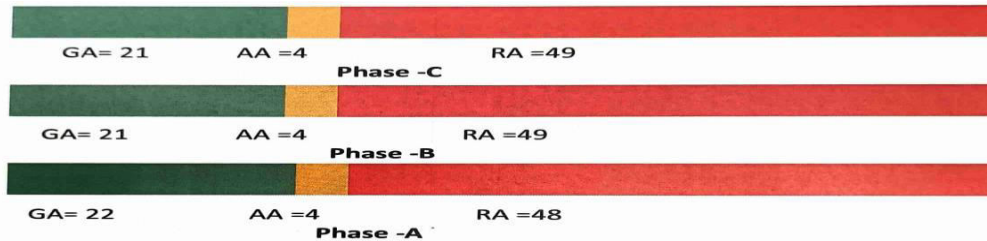


Figure 1: Phase diagram of Irwin Square by PCU Value for urban area

V. CONCLUSION

It has been observed that PCU values given by IRC 93-1985 method gives higher traffic volume thus higher signal timings which is not matching to current signal timings. Hence same signal is designed by considering PCU values suggested for urban roads at signalized intersection. It is observed that the Signal timings calculated by IRC method using PCU values suggested for urban roads at signalized intersection reduces optimum signal cycle time. It is also observed that as the value of Y (Lie. Total volume/saturation flow for critical approach) in Webster's formula approaches to I optimum signal cycle time increases extensively. Hence there is further scope for study to calculate PCU factors for congested city like Amravati where highly heterogeneous traffic conditions prevail. Traffic characteristics of the road can be improved. By doing the above measures accident rates can be decreased. Hence, the death mortality rate can be reduced and driving would be safe on road

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