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Design of traffic signal on NH-12 near Barkatullah University, Bhopal District of Madhya Pradesh

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Abstract - *During the past decade, the major town has under gone hazard growth of Industrialization, urbanization of the country. To manage travel demand the intersection should be given least resistance to traffic flow so that the travel time can become minimized. The present requirement of urban cities is to absorb the growing traffic demand but within the same physical aspect at the intersection. These days all around the globe efforts are being put forward to protect the environment. In this paper, an attempt has been done to study the different intersections, so minimize the delays at these intersections and simultaneous improve the level service. A traffic signal can be synchronized so that a vehicle starting at one end of the Street and traveling at Pre assigned speed can go to another end without stopping for the red light. At each intersection, the existing traffic has been calculated and then signal designed. Improve the level of service at intersections and to minimize delay, optimized signal has been synchronizing and estimated the benefits.*

Key Words: **Signal Design, Webster method, PCU, Field Studies, Straight road, Timing**

1. INTRODUCTION

Traffic signals may defined as power operated signal displays used to regulate or worn traffic. In a broad sense, traffic signals include displays for intersection control, flashing beacons, lane directional signals, and ramp metering signals. When traffic signals are installed and properly operated, they can provide specific advantages in traffic control and safety. Signal installations, however, also have certain disadvantages that may or may not apply at a particular location. The objectives of traffic signals are many, such as they reducing the frequency of certain types of accidents, increasing traffic handling capacity of the intersection, bring but considerable economy over manual control at intersections where alternate assignment of right of way is required and finally, promoting driver confidence by assigning right of way. On the other hand, signal installation at intersections increases the intersection total delay and fuel consumption and Performance Index especially during the off peak periods.

2. LITERATURE REVIEW

2.1 Introduction

A signal design is made by measuring the individual speeds of the vehicles passing a given point (spot) on a street or highway. These individual speeds are used to calculate the speed distribution of the entire traffic stream at that location under the conditions prevailing at the time of study and also calculate individual PCU per hour.

2.2 Advantages of Signaling

Properly designed traffic signals have the following uses:

A) They provide orderly movement of traffic and increase the traffic handling capacity of most of the intersections at grade.
B) They reduce certain types of accidents, notably the right angled collisions.
C) Pedestrians can cross the roads safely at the signalized intersection.
D) The signals allow crossing of the heavy traffic flow with safety.
E) When the signal system properly coordinates, there is a reasonable speed along the major road traffic.
F) Signals provide a chance to crossing traffic of minor road to cross the path of continuous the flow of traffic stream at reasonable intervals of time.

2.3 Signal Design Procedure

The signals design procedure involves six major steps. They include the

(a) Phase design,
(b) Determination of amber time and clearance time,
(c) Determination of cycle length,
(d) Apportioning of green time,
(e) Pedestrian crossing requirements, and
(f) The performance evaluation of the above design.

2.4 Collision Types at Traffic Signals

Single vehicle collisions include vehicles losing control and hitting street furniture, cyclist and motorcyclists falling off their vehicles and collisions in which bus passengers fall either inside he bus or whilst boarding or alighting. Approaching collisions involve more than one vehicle on the approach to the signals, and are typically rear shunts or lane changing collisions. Right angle collisions are those between two vehicles going ahead on adjacent approaches. They only occur at 4-arm junctions and should of course be avoided by the use of signals. The other major group f vehicle collisions is that of principal right turn collisions, in which a right turning vehicle collides with a vehicle from the opposite approach. The effect on safety of aspects of geometric layout and signal operation In a cross- sectional study of 4-arm signals found that after taking account of vehicle flow:

- Wider approach widths were associated with increased right angle collisions and approaching collisions.
- Where there were more lanes at the stop line, there was increased risk of pedestrian
- Collisions with entering vehicles.
- There were fewer right angle (involving vehicles on adjacent roads) and principal right
- Turn collisions (in which a vehicle turning right is hit by an on-coming vehicle) where the opposite arm was displaced, effectively staggering the junction (although only small displacements of up to 13m were included in the study).

2.5 Traffic Studies

Traffic studies or surveys are carried out to analyze the traffic characteristics. These studies help in deciding the geometric design features and control for safe and efficient traffic movement. The various traffic studies generally carried out are:

- Traffic study
- Speed studies
- Origin and destination study
- Traffic flow characteristics
- Traffic capacity study

3. METHODOLOGY

3.1 Introduction

The objective of this study is to get traffic characteristics from NH 12 near Barkatullah university Hoshangabad road Bhopal Madhya Pradesh include manual counting of vehicle and design of signal. This study is used to determine the level of service for streets document congestion and quantify the need for street improvements and also for a variety of purposes. For a design signal at a selected location, a sample of vehicles been count manually and there PCU per hour is indicated. This PCU per hour shows the variation of traffic flow in NH 12. Traffic counts during peak period may show exceptionally high volumes and are not normally used in the analysis; therefore, counts are usually conducted on a 12 days from 2 June to 13 June.

3.2 TRAFFIC VOLUME STUDY

One of the fundamental measures of traffic on road system is the volume of traffic using the road in a given interval of time when the traffic is composed of a number of types of vehicles; it is the normal practice to convert the flow into equivalent P.C.U by using certain equivalency factor. The flow is expressed as PCU per hour.

3.3 PASSENGER CAR UNITS

The flow of traffic with unrestricted mixing of different vehicle classes forms the Mixed Traffic Flow. In a mixed traffic condition, the traffic flow characteristics are very much complex when compared to homogeneous traffic consisting of passenger cars only. It is very difficult to estimate the traffic volume and capacity of roadway facilities under mixed traffic flow. Hence the different vehicle classes are converted to one common standard vehicle unit.

Fig 1 SATELITE VIEW OF OBSERVATION POINT

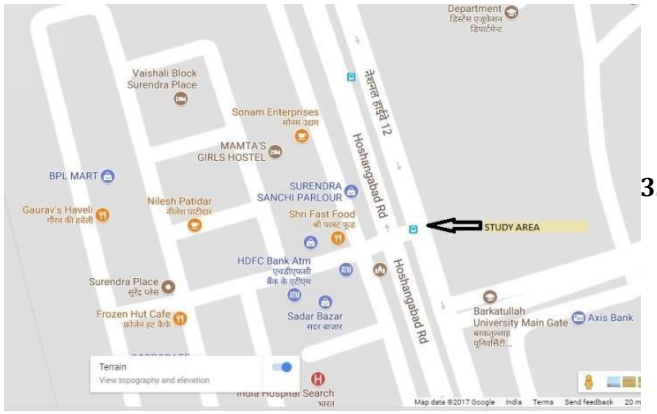

Fig 2 Map sketch of NH 12 near Barkatullah University

3.3 TWO PHASE SIGNALS

Two phase system is usually adopted if through traffic is significant compared to the turning movements. For example in figure 3, non-conflicting through traffic 3 and 4 are grouped in a single phase and non-conflicting through traffic 1 and 2 are grouped in the second phase. However, in the first phase flow 7 and 8 offer some conflicts and are called permitted right turns. Needless to say that such phasing is possible only if the turning movements are relatively low. On the other hand, if the turning movements are significant, then a four phase system is usually adopted.

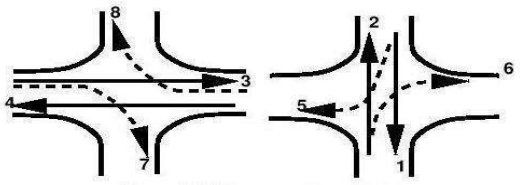

Fig 3 Two Phase Signal

3.4 CYCLE TIME

Cycle time is the time taken by a signal to complete one full cycle of iterations, i.e. one complete rotation through all signal indications. It is denoted by C. In Webster Method corresponding to least total delay to the vehicles at signalized intersection has been worked out. This is rational approach. The field work consists 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.

Width in m	3.0	3.5	4.0	4.5	5.0	5.5
PCU/hr	1850	1890	1950	2250	2250	2900

Table 1.1 Saturation flow for widths 3 to 5.5 meters

3.5 MANNUAL COUNT

Very commonly adopted method to get traffic volume like vehicle class wise, turning movements and loading conditions

- Better than mechanical counters.
- Not practicable for all 24hrs field data.
- Done short counts during peak hours.
- Hence need to perform statistical analysis to calculate the ADT and AADT.

3.5.1 Traffic data collection

Sl.no.	Duration		Total P.C.U.
	START	END	
1	9:00AM	10:00AM	1908
2	10:00AM	11:00 AM	2001
3	11:00AM	12:00PM	2218
4	12:00 PM	1:00PM	2039
5	1:00PM	2:00PM	1556
6	2:00PM	3:00PM	1552
7	3:00PM	4:00PM	1677
8	4:00PM	5:00PM	2060
9	5:00PM	6:00PM	2350
10	6:00PM	7:00PM	2535

Table 2 data collection

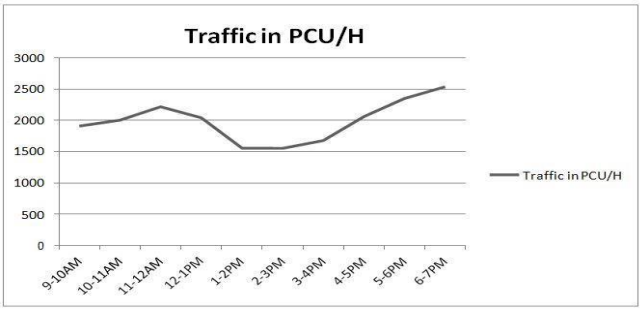

Fig 4 traffic frequency curve

4 SIGNAL PHASE DIAGRAM

TOTAL CYCLE LENGTH
51 SECONDS

Road Toward BARKATULLAH UNIVERSITY

Road toward Misrod

Fig 5 SIGNAL PHASE DIAGRAM

OBSERVED AREA

FIG 6 Vehicle volume data count at first site

Fig 7 Vehicle volume count at last site

5 SPECIFICATIONS FOR SIGNAL POLES (IRC: 93-1985)

5.1 Specifications for Signal Footing (IRC: 93- 1985):

The poles must be first positioned in pits of 900 mm* 900 mm* 1050 mm deep. The poles shall then embed in M 20 concrete to a minimum of 300 mm below ground level and 300 mm above the ground level. The circular area of embedded concrete shall have a minimum diameter of 450 mm. All the cables supplying power to the controller and signal heads shall run through RCC ducts when these are required to cross the carriage way. The ducts shall be of 450 mm internal diameter and laid at a depth of about 1000 mm from the level of the carriage way. For over head traffic signals, the pit should be 1200 mm * 1200mm * 1800 mm deep. The poles are to be embedded in M 20 concreter to a minimum of 500 mm below ground level and 500 mm above ground level. The circular area of embedding concrete shall have a minimum diameter of 500 mm.

5.2 Specifications for Height of Signal Faces (IRC : 93-1985):

The bottom of the housing of a signal face, not suspended over a roadway, shall be at a height of 2.5 meter above the footpath or if none above the pavement grade at the centre (crown) of the roadway. The bottom of the housing of n signal face, suspended over a roadway, shall be at a height of 5.5 meter above the pavement grade at the centre of roadway. Optimum visibility and adequate clearance should be guiding considerations in deciding signal height. Grades on approaching streets may be important factors, and should be considered in determining the most appropriate height. However, the maximum heights of bottom of housing of post-mounted signal face should not exceed 4.6 meter and while in the case of overhead signal face, the same should not exceed 5.8 meter.

5.3 Signal Timings

Inter green periods in India were set many years ago and are based on where collision points occur on the junction. Recent research has confirmed that the amber period should remain at three seconds and the starting amber (red with amber) period at two seconds. All-red periods appear to be beneficial if kept short (generally one or two seconds). Longer all-red periods have been found to be associated with increased principal right turn collisions.

In India, amber periods of between three and six seconds are used, with longer periods at junctions on high speed roads; increasing amber periods to the these values or longer periods on high speed roads as recommended by the Institute of Transport Engineers (ITE) reduces collisions. Amber periods that are shorter than the ITE recommended values are associated with increased collisions. However, inter green periods that are too long may also increase

collisions. Shorter cycle times benefit pedestrians and improve pedestrian compliance, but provide increased opportunities for red running. Cycle times are generally set to minimize vehicle delay but crossings or lightly trafficked junctions in a UTC system can sometimes be double-cycled during off peak periods. Although the type of signal control is generally selected on delay grounds, it can have an effect on safety.

6 CONCLUSIONS

The choice procedures of the economic design traffic volume for signal design in saturated flow conditions are investigated. A traffic count survey was carried out for continuous 9 hours in under normal operation conditions in 12 days. Volumes were measured by approach and direction and consequently, the traffic fluctuation was obtained and the peak volume and the average of peak volumes were determined. It was investigated that the minimum traffic volume presents 85% of the peak volume. Based on the calculations done on the P.C.U values obtained from the traffic survey, the signal cycle length for NH-12 road is 51 seconds for road towards Barkatullah University and also towards Hoshangabad road. By providing signals, there will be reduction in the conflicts.

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