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Traffic Signal Design For Janglat Mandi Anantnag as Per Webster's And Irc Method

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ABASTRACT- The increasing of traffic volume at our intersection has been arise a problems like road accidents, conflicts and congestions. These problems can now only be solved by providing an efficient traffic control at intersections and that can be achieved by provision of traffic signal system at intersections for continuous and efficient movement of vehicles through the intersections. According to traffic signal, signal timing is most important which is used to decide green time of the traffic light shall be provided at an intersection and how long the pedestrian walk signal should be provided. Traffic volume studies are to be made to determine the number, movement and classification of vehicles at the given location. These data is used identify normal flow of the road; determine the influence of heavy vehicles or pedestrians on vehicular traffic volume. The length of the sampling period depends on the type of count being taken. According to manual count with 15-minute intervals could be used to obtain the traffic volume data. The collected data is converted into PCU units. Passenger Car Unit (PCU) is the metric used to convert heterogenic traffic in to homogenous traffic. In India traffic pattern is heterogeneous, it is necessary to convert heterogeneous traffic to homogenous traffic while designing any signalized intersection. PCU Value is dynamic in Nature. PCU value is depends upon current road traffic condition. In India PCU value is based on value given in IRC SP 41. Developed countries devised several methods for calculating PCUs. Webster's method is a rational approach for signal design. The design is simple and is totally based on formulae's laid down by Webster. In this research work the traffic signal for Janglat Mandi chowk is designed by the various traffic surveys.

KEYWORDS-Traffic Signal , Traffic control, cycle length and warrants,,Irc , Webster's,Pcu, Traffic Fields.

I. INTRODUCTION

From the beginning of history, human sensitivity has revealed an urge for mobility leading to a measure of Society's progress. The history of this mobility or transport is the history of civilization. For any country to develop with right momentum modern and efficient Transport as a basic infrastructure is a must. It has been seen throughout the history of any nation that a proper, extensive and efficient Road Transport has played a major role. „Transporters' perform one of the most important activities, at every stage of advanced civilization. Where roads are considered as veins and arteries of a nation, passenger and goods transported are likened to blood in circulation. Passenger Road Transport Service (PRTS) is an essential connected to the economic development. Transport is the essential convenience with which people not just connect but progress. The Spectacular growth in the number of vehicles on the road has created a major social problem the loss of lives through road accidents. The growth of road traffic in India is at a very rapid pace due to industrial growth and socioeconomic changes in th e society. As a result of the steep growth of the motor vehicles, the traffic on the road has been increasing both in terms of volume and intensity. Automobiles have become an essential part of human society for both its day to day functioning and growth. This has resulted in the problem of congestion and casualties on the roads, particularly at road intersections. Urban roads should be designed to be safe and to permit the free flow of traffic at reasonable speed. Their traffic capacity should be balanced against the traffic requirement of the existing and proposed development. India has experienced a tremendous increase in the total number of registered motor vehicles. The total number of registered motor vehicles increased from about 0.3 million as on 3 March, 1951 to about 142 million as on 31st March, 2016. The total registered vehicles in the country grew at a Compound Annual Growth Rate (CAGR) of 9.9% between 2005 and 2016. Figure 1 depicts the share of different categories of vehicles in the tot vehicle population, as on 31st March 2016. Twoal registered motor wheelers accounted for the largest share of 62%, followed by cars, jeeps and taxis (21%), other vehicles (1%), goods vehicles.

II. LITERATURE REVIEW

Mahidadiya et al. (2016) reviewed the Global Scenario on Estimation of Passenger Car Unit. In India, traffic condition is mixed. It cannot be consider all vehicle type as same. As they have different interfere on road traffic. Passenger Car Equivalent (PCE) or Passenger car unit (PCU) is thus a metric used to assess traffic-flow rate on a highway. Passenger Car Unit (PCU) is the metric used to convert heterogenic traffic in to homogenous traffic. In India traffic pattern is heterogeneous, it is necessary to convert heterogeneous traffic to homogenous traffic while designing any signalized intersection. PCU Value is dynamic in Nature. PCU value is depends upon current road traffic condition. These PCU values (devised in developed countries) are not suitable for Indian heterogeneous traffic conditions this paper reviews the estimation carried out to find PCU value worldwide[4].

Reddy et al. (2016) designed the signal for T-intersection by using Webster‟s method in nandyal town, Kurnool district of Andhra Pradesh. Traffic volume studies are to be made to determine the number, movement and classification of vehicles at the given location. These data is used identify normal flow of the road; determine the influence of heavy vehicles or pedestrians on vehicular traffic volume. The length of the sampling period depends on the type of count being taken. According to manual count with 15-minute intervals could be used to obtain the traffic volume data. The collected data is converted into PCU units. Webster‟s method is a rational approach for signal design. The design is simple and is totally based on formulae‟s laid down by Webster[5].

Sharma at al. (2015) studied on the automatic traffic signal system for Chandigarh. The increasing number of vehicles on our road intersections has given rise to the problems like road accidents, congestions, conflicts and bottlenecks. These problems can now only be solved by providing an efficient traffic control at intersections and that can be achieved by provision of automated volume based traffic signal system at intersections for continuous and efficient movement of vehicles through the intersection Chandigarh – the city beautiful – though a modern and well planned city is also facing the same traffic problems[6].

Patil et al. (2014) studied the development of passenger car units (PCU). In this study an attempt is made to find out Passenger Car Unit (PCU) value for Nal Stop. Passenger Car Unit (PCU) value of each class of vehicle is very important for any mixed traffic flow studies. These may be concerning traffic flow parameters, capacity, signal design, parking lots etc. The work took into account the effect of mixing of traffic, speed and headway. A set of PCU values was then derived. The analysis is based on the field studies conducted at Nal Stop in Pune city considering almost all classes of vehicles commonly found in Pune city, India[2].

Veethika et al. (2015)designed the intersections for Improved Traffic Flow at Bhopal Case Studies of Jyoti Talkies Square and Vallabh Bhawan Roundabout. In this paper the signal timings at “Jyoti talkies square” have been redesigned for afternoon peak flow. Improvement by widening of road is recommended. At the other intersection called “Vallabh Bhawan roundabout”, capacity of rotary is calculated w permissible limits or not. Introduction of Signalized rotary is hether it is within suggested[3].

Sachin et al. (2015) designed the signal at intersection of vidisha to control the traffic. In this paper the traffic volume of intersections of the Vidisha city and traffic signals were designed at each intersection.

Chris et al. (2015) has estimated PCE value f or heavy vehicles at three fourleg roundabouts in Vermont, Ontario, Canada and Wisconsin using vehicle movement data collected from video cameras. The PCEs were determined such that the coefficient of variation in 1min entry capacities is minimized. The study also applied the PCEs to theprediction of the entry capacity using the HCM 2010 roundabout capacity model[7].

Mardani (2015) has evaluated that PCU value (figure4) for a vehicle type varies with traffic volume and composition on the road. It is also affected by the type of road as well. Carriageway width also aff ects the PCU value for all types of vehicles. Juremalani et al. (2015) reviewed on the PCU reveals that studies conducted are mostly related to fairly homogeneous traffic conditions, and the few studies conducted under heterogeneous traffic conditions are not comprehensive enough to replicate the field conditions accurately . ObiriYeboahl (2014) employed the headway method for estimation of PCU for the traffic mix and flow conditions prevailing at signalized intersections within the Kumasi Metropolis, Ghana. Vehicles considered were placed in three categories; cars, medium vehicles and trucks[1].

Mehar et al. (2014) has demonstrates the effect of congestion level (v/c ratio) on PCU of different type of v ehicles on multilane interurban highways. Although the PCU values given are derived for Indian conditions, yet the methodology is quite general and can be used by other researchers to derive PCU values for traffic condition in their countries as well. Yahya et al. (2014) has analyzed the average PCE value for heavy trucks in Gaza. It found to be2. 23, whereas it was 1.43 for medium trucks.

III. OBJECTIVES AND AIMS

The main objectives of the study are as follows:

- To quantify the traffic problems on this section and identify the necessary actions to improve those traffic problems.
- To conduct necessary traffic studies on the selected stretches of‟ the road in order to know existing traffic conditions.
- To appreciate movement that can he achieved by applying Transportation System Management actions.
- To suggest some effective measures to prevent traffic problems on Road in future.
- To be used for the analysis of traffic patterns and trends.
- Turning movement study is used in the design of intersection.

- Pedestrian volume study is used for planning pedestrian signal. The main aim of studs is to bring out major causes or congestion on the road and suggest their remedies.

A. Traffic Signal Design

Traffic signals are manually, mechanically or electrically operated devices which by means of its indications, direct traffic to stop or to proceed at intersection. The indication shown by a signal face is an aspect which follows a sequence or red, red and amber together green and amber. Thus signals are widely used in the assignment of right of way intersections.

B. Scope of Study

The scope of the study encompasses appreciation of identifying the road sections for conducting necessary traffic studies and to quantify problems with view to suggest improvement measures. The traffic studies include Traffic Volume Count Study. Spot Speed Study These traffic studies would enable quantification of traffic flows, identification of causes for delay and inefficiency besides traffic accidents.Keeping in view the scene of the city with the existing traffic problems and as a part of continuing programme of reviewing and redesigning Intersections, the main object of this investigation is to critically study road intersections with reference to their traffic control measures traffic performance and main objectives of the study are as follows:other relevant features and thereafter redesign them according to the requirement of the present and future traffic and Suggest improvements in their present layout. The conclusions and recommendations from these studies will be helpful in better understanding of the problems and finding of the effective measures to overcome all those problems.

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C. Presentation of Research

The study work undertaken for the research has been worked out in six chapters.

Chapter 1 “Introduction” it gives an overview about the dissertation topic and its importance, objectives of research work and scope of research work. The Webster‟s and IRC methods for deter discussed. mination of optimum cycle length and green time are also Chapter 2 “Literature Review” includes the guideline provided by various authors on criteria for signal control, types, cycle length and warrants. Chapter 3 “Special Characteristics of Tra ffic Signals” gives the description about various special characteristics of traffic signals, which includes traffic signs, markings, police control and roundabout. Chapter 4 “Field Study and Data Collection” it includes speed spot study, traffic data of i ntersection collected at Janglat Mandi Chowk intersection.

Chapter 5 “Design of Signal Timing” it gives detailed analysis on design of signal timing for intersection in comparison with existing timing, as per Webster‟s and IRC method.

IV. TEST METHODOLOGY

- Need of the study.
- Sand Need of the study.
- Scope and objective of thestudy.
- Study stretch and data
- Collection.
- Classified Traffic surveys.
- volume count.
- Road inventory
- Capacity evaluations.
- Literature review.
- Re-design of signal timings.
- The different phases involved in methodology shall
- be summarized as follows:

V. DATA ANALYSIS AND RESULTS

A. Traffic Volumestudy

The traffic volume study was carried out during 6:00 A.M. to 10:00P.M. Figure 1 shows the Road map of the area.The study was carried out for three different days of the weak including one holiday so that variation of traffic volume during different weak days can be known. Data collected was converted into one common unit i.e. Passenger Car Unit commonly known as PCU. Following values of PCU as given by IRC for signal design were taken. As the no of vehicles drawn by animal are less, so they are considered into the other category as shown in Table:1

Table l: Passenger Car Unit for Different Class of Vehicles

Class of Vehicle	**Car/Jeep/ Van /Taxi**	**Scooter/ Motorcycle/ Three-wheeler**	**Cycle/ Cycle Rickshaw**	**Light Commercial Vehicle/other**	**Bus/ Truck**
PCU value	1.00	0.33	0.20	1.75	2.25

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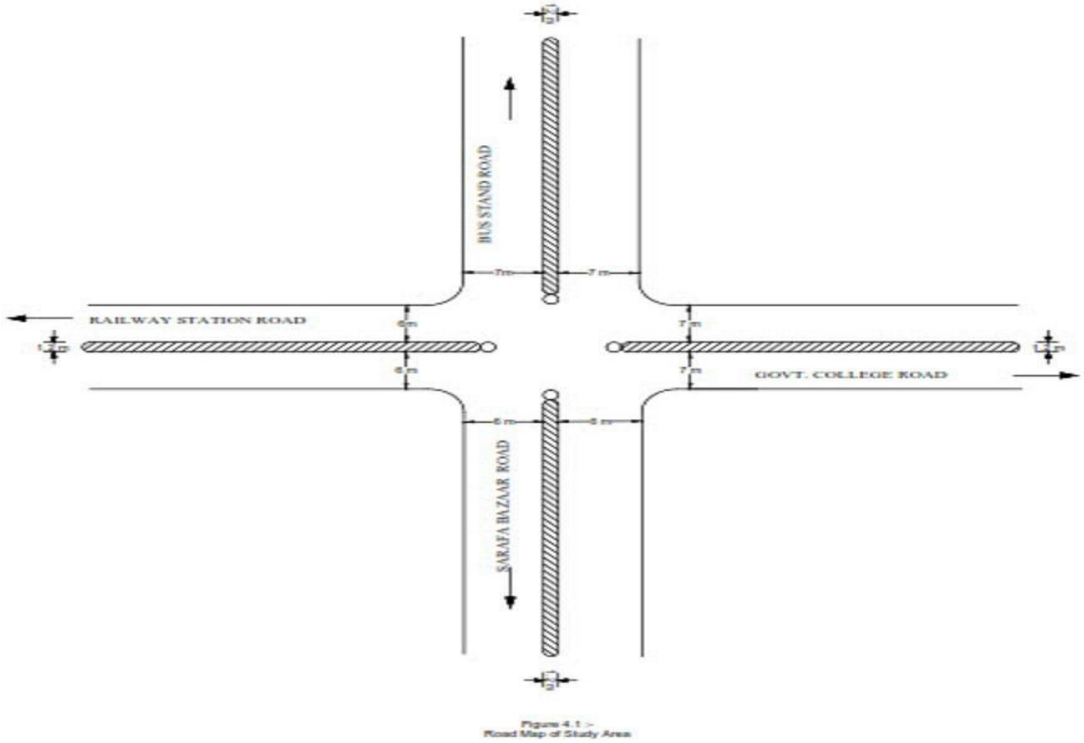

Figure 1: Road map of study area

Based on the study traffic volume count chart‟s and traffic flow diagrams for different interactions were made as shown. Seasonal factor of 1.2 must be applied for taking into account any change in the traffic volume due to variation in climatic conditions. It was observed that the traffic volume is high mainly during morning peak time. This is mainly due to the same opening timing's of different offices and institutions. Based on the Study the traffic in the future can be predicted by the following formula and results indicated in tabular form below in Table 2:

$A = P (l + r)(n+10)$

Where

n= Constant period of intersection taken as Zero r= Rate of Volume increased per year to be 0.1. P=Present volume.

A= Projected volume in the year 2023.

Table 2: Predicted Traffic volume

Intersection	Present traffic volume in PCU/Hr	Predicted traffic volume in PCU/Hr
Intersection	4344	12916

The results clearly show the traffic Volume alter 10 years will be very highfor intersection. Therefore immediate steps must be taken in direction to overcome traffic problem onintersection. Design of signal scheme includes selection of types of signals, number of phases, amber period, cycle time and time allotted to each phase and other specified features such as exclusive turning phase or pedestrian phase. Based on the field traffic studies data, the signal timings are calculated by Webster‟s method as modified by IRC.

B. Janglat Mandi Chowkintersection

The four phases that exists at the intersectionare:

Phase I : RailwaySide

Phase II : Sarafa bazaar RoadSide

Phase III: Govt CollegeSide

PhaseIV : Bus Stand Side

Calculation of Saturation Flow

Saturation Flow for traffic from different rounds in PCU/Hr bus been worked out taking into account the good site characteristics and as such saturation flow values have been taken as 120% of the standard value.Table :3 shows the Calculation of Y Value for Intersection

Lane A from railway RoadSide

For Straight and Left TurningTraffic

AverageWidth = 6m

SaturationFlowS1 $=1.2 \times 525 \times w$

$=1.2 \times 525 \times 6$

=3780 PCUs/Hr

For Right turning traffic

$$\text{Saturation Flow } S2 = \frac{3000\times1.2}{1+1.52/r}$$

$$=\frac{3000\times1.2}{1+1.52/15}$$

=3269 PCUs/Hr

Lane B from Sarafa Bazaarsidea) For Straight and Left Turning TrafficAverageWidth = 6m

SaturationFlowS1 =1.2 × 525 ×w

=1.2 × 525 × 6

=3780 PCUs/Hr

b) For Right turning traffic

$$\text{Saturation Flow} \qquad S_2 = \frac{3000\times1.2}{1+1.52/r}$$

$$=\frac{3000\times1.2}{1+1.52/15}$$

=3269 PCUs/Hr

Lane C from Govt College road Sidea) For Straight and Left Turning TrafficAverageWidth = 7m

SaturationFlowS1 =1.2 × 525 ×w

=1.2 × 525 × 7

=4410 PCUs/Hr

b) For Right turning traffic

$$\text{Saturation Flow} \qquad S_2 = \frac{3000\times1.2}{1+1.52/r}$$

$$=\frac{3000\times1.2}{1+1.52/15}$$

=3269 PCUs/Hr

Lane D from Bus Stand Sidea) For Straight and Left Turning TrafficAverageWidth =7 m

SaturationFlowS1 =1.2 × 525 ×w

=1.2 × 525 × 7

=4410 PCUs/Hr

b) For Right turning traffic

$$\text{Saturation Flow} \qquad S_2 = \frac{3000\times1.2}{1+1.52/r}$$

$$=\frac{3000\times1.2}{1+1.52/15} = =3269 \text{ PCUs/H}$$

Table 3: Calculation of Y Value for Intersection

From	Railway Side			Sarafa Bazaar Side			Govt college Side			Bus Stand Side		
To	L	S	R	L	S	R	L	S	R	L	S	R
Present traffic flow PCU/hr	336	412	277	208	345	285	377	543	615	470	339	514
Correctio n for left turn (+25%)	84			52			94			117		
Phase-I Total flow,,q1‟	832		277									
Saturatio n Flow ,,S1‟	3780		3269									
Y-value Y1=q1/S1	0.22		0.08									
Phase-II Total flow ,,q2‟				605		285						
Saturatio n Flow ,,S2‟				3780		3269						
Y-value Y2=q2/S2				0.16		0.08						
Phase-III Total flow,,q3‟							1014		615			
Saturatio n Flow ,,S3‟							4410		3269			
Y-value Y3=q3/S3							0.23		0.18			
Phase-IV Total flow,,q4‟										926		514
Saturatio n Flow ,,S4‟										4410		3269
Y-value Y4=q4/S4										0.21		0.16

Calculation of Optimum Cycle Length

Based on the approach speed at the intersection and as per British practice, the following assumptions can be made:
InterGreenPeriod I=4seconds
AmberPeriod a=3seconds
Time Lost due tostartingDelays l=2 seconds per phase
Total lost time per cycle L is calculatedbelow:
L= ∑ (I-a) +∑l L=4(4-3) +4×2
L=12 seconds Optimum Cycle Length Co is calculated below:
Co=128
Green Time Apportionment
C = Optimum Cycle length

Now $$Co = \frac{1.5L + 5}{1 - Y_1 - Y_2 - Y_3 - Y_4}$$

$$Co = \frac{1.5 \times 12 + 5}{1 - 0.22 - 0.16 - 0.23 - 0.21}$$

appropriate green time for each phase shall he computed. It has been found that least delay occurs when the effective green time for each phase is proportional to its Y value. The above rule gives:

$$g_n = \frac{Y_n}{Y_1 + Y_2 + \cdots \ldots \ldots + Y_n} \times (C_o - L)$$

L = Total Lost time per cycle Co - L = Effective green time.

Phase – I

$$g_1 = \frac{Y_1}{Y_1 + Y_2 + \cdots + Y_n} \times (C_o - L)$$

$$g_1 = \frac{0.22}{0.22 + 0.16 + 0.23 + 0.21} \times (128 - 12)$$

$$g_1 = 31$$

Phase – II

$$g_2 = \frac{Y_2}{Y_1 + Y_2 + \cdots + Y_n} \times (C_o - L)$$

$$g_2 = \frac{0.16}{0.22 + 0.16 + 0.23 + 0.21} \times (128 - 12)$$

$$g_2 = 23$$

Phase – III

$$g_3 = \frac{Y_3}{Y_1 + Y_2 + \cdots + Y_n} \times (C_o - L)$$

$$\square_3 = \frac{0.23}{0.22 + 0.16 + 0.23 + 0.21} \times (128 - 12)$$

$$\square_3 = 32$$

Phase – IV

$$\square_4 = \frac{\square_4}{\square_1 + \square_2 + \cdots + \square_\square} \times (\square_\square - \square)$$

$$\square_4 = \frac{0.21}{0.22 + 0.16 + 0.23 + 0.21} \times (128 - 12)$$

$$\square_4 = 30$$

Minimum green time is, however, governed by the reed of the pedestrians at the intersection and taking the widest approach of the intersection is calculated as follows:

TakingPedestriansspeed = 1 .2 m/sec.
Time to cross 8m wide approach = 8/1 .2 = 6.67 sec.

Adding initial starting interval of 7 sec. (pedestrians reaction time = 7 sec.) Total time =6.67+7 = 13.67 seconds
As per IRC guidelines, the minimum green time required for the vehicular traffic on any of the approached is limited to 16 seconds.
Therefore increase Green time of phase III and phase IV to 16 seconds.Hence g3 =16seconds, g4 = 16seconds
Taking amber period as 3 seconds after each green time New Cycle length =31+3+23+3+32+3+30+3=128

As per H.M.S.O. "Technical Paper Number 56", the cycle length is in between 0.75 Co to
1.5 Co. Hence the delay will not be more than 10 to 20 % above that given by optimum cycle.
Table 4 is showing the Total Green Time including Red/Amber time. Figure 2 shows the Phase Signal Timing at Janglat Mandi Chowk Intersection

Table 4: Total Green Time

Gn = gn + Ra G1=31+2=33 sec.,G2=23+2=25 sec. G3=32+2=34 sec.,G4=30+2=32 sec. Controllers setting for various phases:	Gn-a
For Phase I :	33-3=30 sec.
For Phase II :	25-3=22 sec.
For Phase III :	34-3=31 sec.

For Phase IV : 32-3=29 sec.
The timing and phasing diagram is shown in figure-5.1

C. Designed Signal Timings

Based on the study and analysis work being carried out signal timings has been made in the table 5 given below:

Table 5: Signal Timings

Road Side	Phase	Signal Aspect	Designed Signal Time (seconds)
RAILWAYSIDE	I	Green Amber Red	30 3 95
SARAFA BAZAAR ROAD SIDE	II	Green Amber Red	22 3 103
GOVT. COLLEGE SIDE	III	Green Amber Red	31 3 94
BUS STAND SIDE	IV	Green Amber Red	29 3 96

VI. CONCLUSION

Both the present and future traffic/pedestrian volume as well as the existing geometric layout should be given due consideration, while a consideration is being made between different traffic control measures, otherwise the improvement is likely to result in an over or under designed traffic intersection with its consequent traffic difficulties.
In urban area, signals are found to be more efficient and suitable than the roundabouts due to space restriction. But in rural areas, roundabouts may be used with great efficiency.
The geometric design of the selected intersection is not in accordance with the IRC specification. Traffic is uneven on the four legs of intersection but still the road having more traffic have less width. The rational method to design the signal timing scheme is only Webster"s method. It gives least delay and optimum cycle time; therefore, Webster"s method should be used for designing signal scheme.
The main contribution factor to the lock up at intersection is the heavy traffic volume during morning and evening peak hours, which was not considered at the time of design of the intersection.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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