Traffic Analysis and Design of Signalling System for Pedestrial Interaction at Pusad Naka Road, Washim

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Abstract

Several studies are there to understand the pedestrian movement and all the studies are based on fundamental diagrams only. These studies construct a base to characterize pedestrian flow. Several experiments have conducted to understand the pedestrian flow, likewise some field observations have done to represent fundamental diagrams. Therefore, before going to analyze the data from the observation, it is necessary to note down the pedestrian flow parameters carefully. The aim of the paper is to build up the base to fundamental diagrams and for characterization of pedestrian. And derive the required flow diagrams and results from the field observations. Field survey is conducted to know the vehicle pedestrian interaction, and this field data with respect to pedestrian crossing at signalized, Unsignalized or at midblock sections 6is aimed to be observed. And the impact of vehicle pedestrian interaction at several intersections/midblock sections is to be studied. This data is used to determine the normal traffic flow and the impact of heavy vehicles or pedestrians on the volume of traffic. The information gathered is converted into PCUs (Passenger Car Units). Webster's method of signal design is logical. The design is straightforward and entirely based on Webster's formulas. The complete signal cycle is thus determined by what causes the shortest complete delay in the signal. To do this, several places are chosen from Pusad Naka Washim. It is aimed to observing whether the pedestrian fundamental diagram is different in alternate locations or not. In this study it is found that fundamental diagrams are different in different locations of Washim

Keywords: (Pedestrian, sidewalk, mid-block, PCU, crossing behavior, signalized intersection, mix traffic, vehicular characteristic, Webster Method, Signal Design.)

1. Introductions

In ancient ages there was a huge pedestrian walking take place and walking is the only mode of transportation. Walking has always been the primary means of human motion and that's why we considered the pedestrians are the basic elements of transportation. In ancient ages there was a huge pedestrian walking take place and walking is the only mode of

transportation. For every transport related to travel and journeys must begin and end in walking. This pedestrian walk is an effective mode of transportation for short trips.

Walking is a major mode of transportation in Indian cities also. In order to provide the best design spaces for human motion or circulation like at airport corridors, shopping malls, subways etc. for that pedestrian motion is studied empirically in all aspects. It is carried away by two levels. At macroscopic level one can analyze the basic flow parameters like speed, density of pedestrian motion and at microscopic level one may track the paths followed by individual pedestrians while moving respectively. From this it is clear that the pedestrian may create own paths in their journey trip. Coming to the pedestrian crosswalks there were several cross walks like zebra crossing are designed for a road, provide gainful work to assist the pedestrians to move from one side to the other side of road, and which plays a significant role in the mobility and safety mode of signalized intersections. In some other places like where the busy traffic takes place, pedestrian choose the mid blocks to cross the road. But there is no safety as compared to signalized intersections. Even many pedestrian crosswalks are taking place in these midblock sections.

Necessity for Traffic Signals

Traffic lights are signalling devices that control traffic flow at road intersections, pedestrian crossings, and other locations. By displaying lights of a standard colour (red, amber (yellow), and green) that follow a universal colour code, traffic lights alternate the right of way given to users in the usual order of colour phases.

The green light allows traffic to proceed in the indicated direction if it is safe and there is space on the other side of the intersection.

The amber (yellow) light indicates that the signal is about to change to red. On a yellow light, some jurisdictions require drivers to stop if it is safe to do so, while others allow drivers to proceed through the intersection if it is safe to do so.

A flashing amber indicator serves as a warning.

A flashing red indication is treated as a stop sign, and a red signal prohibits any traffic from proceeding.

2. Methodology

To establish the effect of the pedestrian crossing on the speed and capacity of the urban road the data collected at Washim city in Maharashtra. To assess the effect of pedestrian crossing it is essential to conduct the survey at the section with and without the effect of the pedestrian crossing on the urban road. The mid-block section with the effect of the pedestrian crossing is termed as 'friction section' whereas the mid-block location where there is no any such influence observed is termed as 'base section'. A photographic survey was conducted at Washim city.

Fig. Image taken during data collection

Observation & Data Collection

The pedestrian flow may take place in a unidirectional, bidirectional, or multi-directional. They do not prefer travel in extreme clear path/lanes although they may do sometimes under heavy traffic. To do that recorded data or experimental/field data is to be taken to extract the pedestrian speed, density and several parameters which are very useful for the study.

There are several experiments were conducted at intersections and midblock. The first experiment was conducted at Washim on disturbed pedestrian movement intended to study the impact of motorized vehicles on the pedestrian. From daily market undisturbed pedestrian movement was recorded to compare with the disturbed data set. The yield of this study is to show the fundamental difference between speed and density of the pedestrians.
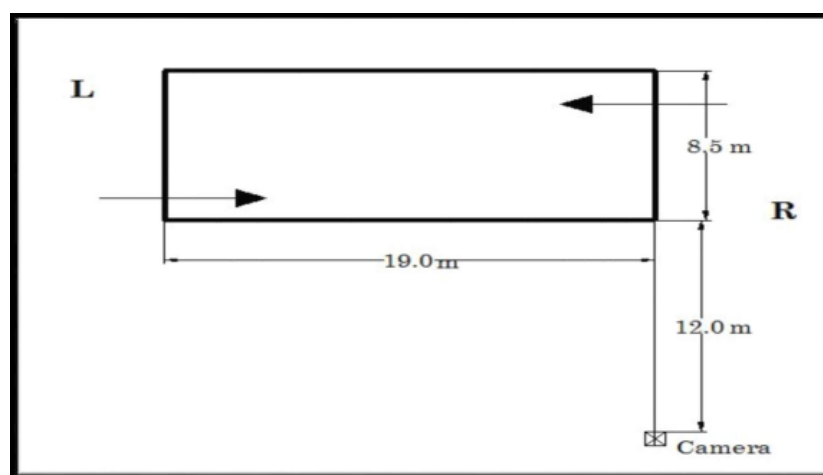
Fig. Data collection

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Study Detailing:

1. The traffic volume Study at Pusad road.

2. The traffic flow survey at intersection from time 9am to 11am and at evening 5pm to 7pm.

3. The traffic at junction mostly in early morning and in evening so here seems that most of the traffic issues of junction is occurred by pedestrian, animals, parking and significant vehicle. To sort out these issues of traffic the subway ought and bridge to be provided.

Traffic investigation methods. There are two methods for conduction of traffic volume counts;

i.e.1) Automatic count method . 2) Manual count method.

Automatic Count Method

An automatic count method is completely based on automatic system. In automatic count method the data will be recorded by using video graphic images and sensors which is record the number of vehicle passes away.

Manual counts are normally collect information for determination of auto classification, direction of travel, pedestrian movement, turning movement or vehicle occupancy

An automatic count generally gives the information for determination of auto hourly patterns, daily or seasonal differences and growth trends, or annual traffic estimates. The choice of study strategy ought to be determine injury count amount and the count amount ought to be illustrative of the time of day, day of month, month of year for study space. For instance, count at a summer resort wouldn't taken in January. The count amount ought to avoid special event and compromising atmospheric condition (Sharma 1994). A count period could vary from five minutes to one year. Usually count period are quarter-hour or a pair of hour for peak period, four hours for morning and afternoon peak, six hours for morning, mid day, and afternoon peak and twelve hours for daytime periods (Robertson 1994).Thus, for instance, if you were conducting a 2hour peak amount count, 8-15min count would be requiring.

Manual Count Method

Most of utilization of manual count essential little samples of knowledge at any given location. Manual counts are usually used once the problem and expanse of machine-drive instrumentation are not even. Manual counts are important sometime instrumentation is not on the market. Manual count normally used for the period of daily basis. Normal intervals for a manual count are 5, 10 and quarter hour. At the day time of Monday and evening time of weekday show inconsistent high volume. Therefore, sometime count may conducted on Tuesday, Wednesday or Thursday.

Manual counts recording methods

There are three methods i.e, .1)Tally sheets method, 2)Mechanical counting board 3) Electronic counting boards.

Tally Sheets Method

In a manual count recording, tally sheet method is the simplest way for recording the information. And this information usually recorded with a tick mark on a pre-prepared field type. In this method a watch and timer is necessary to live the required count interval.

## Experimental Road Section Results

The result shows the fundamental relation between the speed-density and speed-distance headway of pedestrian flow. As referring U Chattaraj et al. (2009) for comparison of fundamental diagrams across cultures. And the differences between the disturbed and undisturbed pedestrian flow is shown by hypothesis testing. Regression analysis has been conducted to get the statistical results. Simple linear regression analysis is well known statistical technique for fitting mathematical relationship between dependent and independent variables.

From the manual count method pedestrian flow is calculated for every 5 minutes. From this it is noted down that the pedestrian flow varies from section to section and from place to place. The size of the data collection depends on the length of the counting period, the type of count being performed, crosswalks being observed and the road conditions.

WORK PERFORMED

Vehicles Counting

The various data collected in the form of vehicle counting which is shown in below the bar graph from Day 1 to Day 3 as follows:

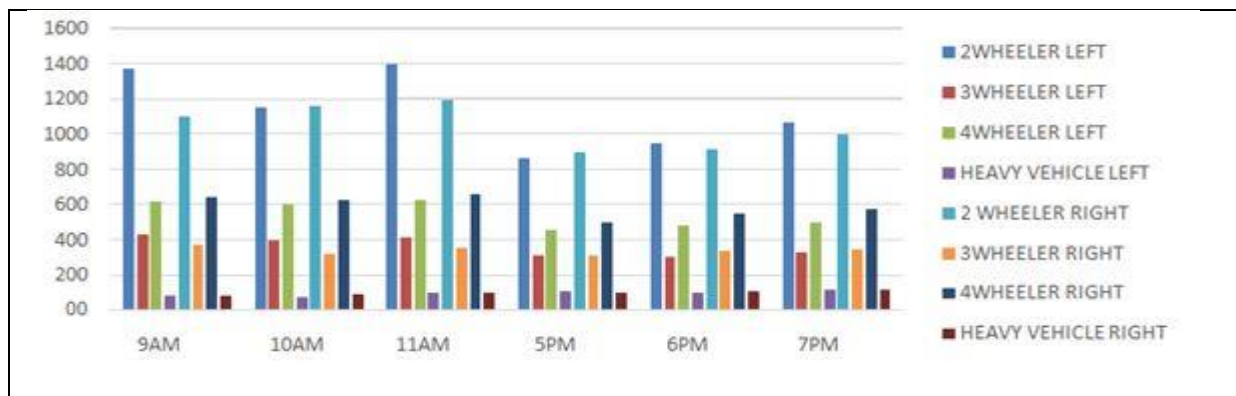| Fig. Vehicle Counting on Day 1 | Fig. Vehicle Counting on Day 2 |
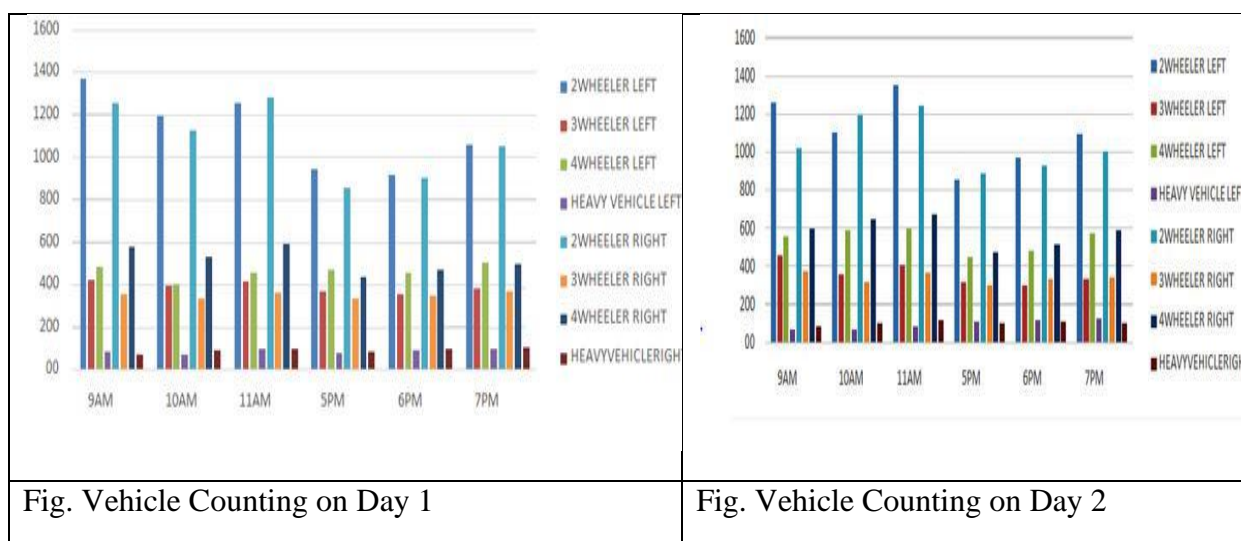
Fig. Vehicle Counting on Day 3

In above graph shows time verses volume density in different day (i.e. Day1, Day2 and Day3). The vehicle counting peak hours in morning and evening different types of vehicle i.e. 2 Wheeler, 3 Wheeler, 4 Wheeler and heavy vehicle are counting right and left sides

Implementation of Study

Road controlling is given the authority to erect regulatory signs which includes GIVE WAY AND STOP sign .Associated road markings are required by the Traffic Regulations signs and marking must be present to have legal effect, except where the surface type of it impractical to provide markings, unsealed road. The required marking are detailed in guide to urban road marking. It should be noted that the current edition of the manual of traffic sign and marking shows 'STOP' or 'WAY' letters starting a maximum of 10m from the limit line. To make sure the Traffic Regulations are complied with the whole of the world of the word should be within 10m. Further instruction given in the sign manual.

Replication of sign may be desirable as outlined in these guidelines. This is specified in the definition of 'Intersection' in the interpretation clause of the Traffic Regulation of mid block section and intersection. They are important to ensure uniform national standards and to avoid confusion

Guidelines for use and construction of speed control hump are discussed in legal aspects of speed reduction devices. And guidelines for implementation of traffic control at cross road are discussed in new ministry publication and also discussed the procedures for the choice of traffic control at a particular uncontrolled crossroad. It provides a suitable reference to matter such as visibility distance, appropriate legal matters and practical aspects, approaching vehicle speed of road. In particular it contains new criteria for the installation of stop sign based on the safe approaching speed. Proper information can also be found in the manual of traffic signs and markings. It has been agreed that the section of manual dealing with give way and stop sign will be modify to give effect to this policy and be consistent with the guidelines. Still the implementation of the policy should be undertaken by road controlling authorities using their own staff or consultants.

Road Width: Traffic controls are reducing for implementation of road width for improper

road and side of parking facilities provide.

Signal: Traffic signals are provided at road intersection this are control device which could alternatively direct to stop and proceed. Traffic signals are worked from the automatic and manually. Sometime the signals are not work properly so the traffic are produce to the signal the maintenance and special control room are provide for better work of traffic control reduce and some small place of road intersection the battery of signal provide to maintained the traffic flow.

Sign: Road sign are provide for road side corner to inform the road user of certain laws, and regulation. This sign are inform the road user for proper guidance so the vehicular are proper way so the traffic is reduced.

Marking: The road marking to reduce the traffic control for improper parking of vehicles the marking sign of road side provider of yellow color of line parking to provide the vehicle are park and

marking sign implementation of road marking of redline are provide to implement the road at night vision of road clearly show .

Island: The road intersections of island are providing for bigger size so the traffic is reduced.

Traffic signal: Traffic signals are electrically operated traffic control devices which alternately direct traffic to stop and to proceed. This discussion tells what factors enter into traffic engineer's decisions to install traffic signals. Because there is a common belief that signals are the answer to all traffic problems at intersections, this is offered in the interest of developing broader public understanding about what signal will do and what they won't do. A number of definitions and notation need to be understood in signal design. They are discussed below:

- **Interval:** Accordingly it indicates the change from one stage to another stage. In this there are two types of interval i.e. i) change interval and ii) clearance interval. A change interval may also called yellow time indicates the interval between the green and red signal indication for an approach. Now clearance interval may also called all red is included after each yellow interval indicating a period during which all signal faces sow red and it is used for clearing off the vehicles in the intersection.

- **Green Interval:** It is denoted as GI and it is the green indication for particular movement or set of movement. This is the actual duration the green light of a traffic signal is turns on.

- **Red Interval:** It is denoted as RI and it is red indication for particular movement or set of movement. This is the actual duration he red light of a traffic signal is turned on.

- **Phase:** A phase is a green interval plus the change and clearance interval that follow it. So that during green interval, no conflicting movement are allot into each phase.

▪ **Lost Time:** It indicate the time during which the intersection is not usefully for any movement. For example, when the signal for an approach turns from red to green ,the driver of the vehicle which is in the front of the queue will take some time to sense the signal it is usually called as reaction time and sometime will be lost here before they moves.

A complete series of stages during which all traffic movements are served in turn is known as a cycle. The cycle time is the sum of each of the stage times.

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Design of Traffic Signal Using Webster Method

Passenger Car Unit

The PCU can be thought of as a measure of a vehicle class's relative space requirement compared to that of a passenger car under a set of road, traffic, and other conditions. The PCU value of a particular vehicle class can be calculated as the ratio of a roadway's capacity when only passenger cars are present to the same roadway's capacity when only vehicles of that class are present.

From irc:106-1990, PCU factor for different types of vehicles:

| S. NO.	VEHICLE TYPE	PCU FACTOR
1	2 WHEELERS	0.5
2	3 WHEELERS	1.2
3	CARS	1
4	CARGO VANS	1.4
5	TRUCK AND BUSES	2.2
6	TRACTOR	4

Methodology of Traffic Signal Design

Five key steps are included in the signal design technique. They consist of:

1. Designing the phase

2. Clearance and Amber Time Calculation

3. Determining the length of a cycle

4. Apportioning of Green Time

5. Assessing the above-mentioned design's performance

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The goal of phase design is to divide conflicting movements in an intersection into different phases in order that movements within each phase don't conflict. A large number of phases are required to separate all of the movements without causing conflicts.

Consider a four-legged intersection with through traffic and right turns to illustrate various phase plan options.

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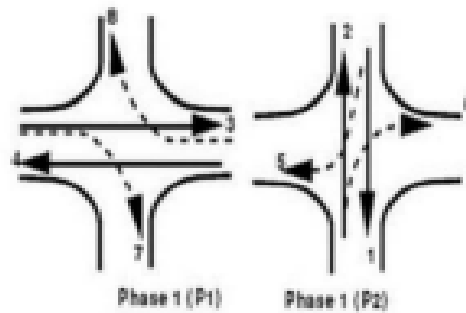
Phase Designed

|	
1. Old City Road to Hingoli Road & Pusad Road	**2. Pusad Road to Akola Road & Old City Road**
3. Akôla Road to Hingoli Road & Old City Road	**4. Hingoli Road to Akola Road & Pusad Road**

Traffic Flow Data

The data has been collected between 30 Nov 2020 to 4 Dec 2020 are shown in below Table

Table 1. Traffic Flow Data In PCU

TIME/DAY	MON	TUES	WED	THUR	FRI	AVERAGE
8-10 AM	3179.1	3146.5	3268.2	3154.5	3161.2	**3181.9**
12-2 PM	2480.6	2329.1	2438.1	2733.5	2658.8	**2528.02**
5-7 PM	2882.8	2895.9	2810.4	2993.6	2913.9	**2899.32**

The traffic flow data in terms of PCU and graphical representation of traffic flow data showing comparison of traffic on various days at different time interval and percent composition of vehicles are shown in below fig.
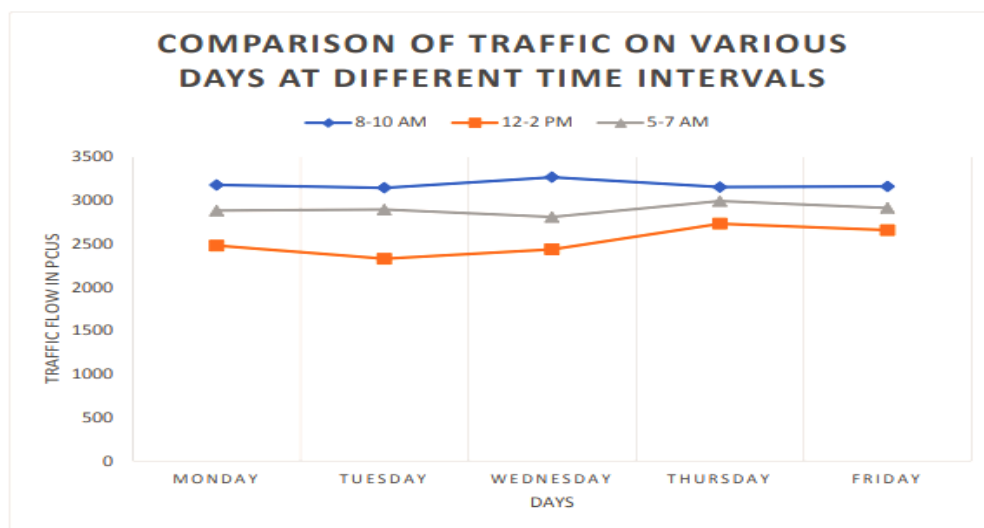
PERCENT COMPOSITION OF VEHICLES

■ 2 WHEELERS   ■ 3 WHEELERS   ■ CARS   ■ CARGO VANS   ■ TRUCK AND BUSES
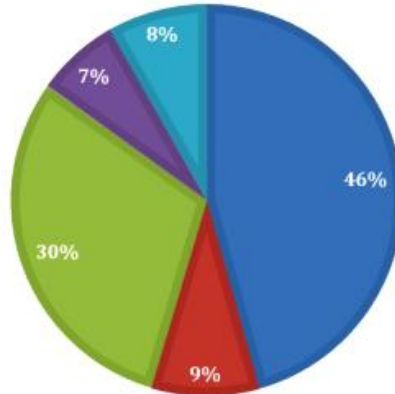
MORNING SESSION

PHASE	DESIGNED CYCLE LENGTH	DESIGNED GREEN TIME	EXISTING GREEN TIME
1	126 SEC	32 SEC	25 SEC
2		34 SEC	28 SEC
3		17 SEC	15 SEC
4		25 SEC	20 SEC

AFTERNOON SESSION

PHASE	DESIGNED CYCLE LENGTH	DESIGNED GREEN TIME	EXISTING GREEN TIME
1	97 SEC	21 SEC	25 SEC
2		20 SEC	28 SEC
3		18 SEC	15 SEC
4		20 SEC	20 SEC

EVENING SESSION

PHASE	DESIGNED CYCLE LENGTH	DESIGNED GREEN TIME	EXISTING GREEN TIME
1	120 SEC	26 SEC	25 SEC
2		29 SEC	28 SEC
3		23 SEC	15 SEC
4		24 SEC	20 SEC

Conclusion

On a junction the three phase signal is provided & Calculating the signal cycle based on based on Passenger Car Unit values we obtained from Traffic Survey, for Morning session the Signal Cycle Length obtained is 126 seconds, for Afternoon session the Signal Cycle Length obtained is 97 seconds and for Evening session the signal cycle length obtained is 120 seconds and we get separate green time for each phase which will help in Conflict Reduction; & Orderly movement of traffic. Also mid-block section is on the route of the Pusad Naka most of the traffic going towards the Hingoli Road, Akola Road, Old City Road and some Hospitals have to cross the road so the design criteria of this signal should be as per guidelines.

1. To provide zebra crossing near traffic end of the radius for people can safely crossing the road among three phases.

2. A signal with traffic police should be provided.

3. As per requirement Traffic marking and islands should be provided.

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