Estimation of Capacity under Mixed Traffic Flow Condition at Un-Signalized T-Intersection (QAMARWARI CHOWK, SRINAGAR, J&K)

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Abstract

Several attempts have been made to develop different approaches for the analysis of un-signalized intersections under Mixed, Major and Minor traffic conditions. Conflict technique is a recent development, which is based on practically simplified concept, considering interaction and impact between flows at intersection and using different mathematical models by calibrating their accuracy. In present study, capacity of un-signalized T-intersection was calculated from Conflict technique. Surveys were conducted at "Qamarwari junction" to measure different traffic parameters like Volume, Flow and Capacity. Movement capacities were evaluated by using HCM (2000) for comparison with approach wise capacities obtained from conflict technique from different directions on the study area.

Keywords

Conflict technique, Capacity, Surveys, Tanner Model, Traffic Parameters, Un-signalized T-Intersection

I. Introduction

Kashmir needs no introduction as its history spread over more than 5000 years. Srinagar being the capital has grown many folds during last century mainly after independence. With the growth traffic has also increased many folds as transportation is inseparable part of any developing/developed society.

Srinagar being the capital is connected to different districts through network of roads which in turn forms a number of junctions in and around the city. One of such junctions is Qamarwari junction which connects Srinagar city with four districts namely Baramulla and Kupwara in one direction, Bandipora in the other and Ganderbal in the third direction. The junction attracts a lot of traffic especially during peak morning and evening hours. Since the junction is poorly developed as per present day demands thus results in average delay of one hour per day for the commuters. It is in pace to mention that development of the junction has not taken place partly due to turmoil for last two and a half decades and partly due to negligence on the part of politicians. Srinagar City is undoubtedly the busiest part of the Kashmir valley considering its strategic position and the importance of roads which it forms link to. It has been witnessing harrowing traffic jams for years while state government despite embarrassments at the highest levels has done nothing. During the peak hours, the traffic on the busy roads remains badly affected as vehicles are seen stranded. The queues at times last for hours & extend up to distances in kilometres resulting in serious worry for commuters.

Traffic consists of bi-directional freedom traffic on Srinagar roads such as two or three wheeled vehicles and uni-directional vehicles such as four wheelers. While the above tend to overtake or turning or crossing or right turn even if a small gap is available. Hence, to determine the intersection capacity traffic engineer requires a clear understanding of gaps being accepted or rejected by various modes of traffic. Besides, in these mixed traffic conditions, users do not usually follow lane discipline and can occupy any lateral position on the road. To prevent traffic accidents, conflicting traffic streams are separated either in space or in time.

There are several types of capacity analysis models for un-signalized T-intersections. Capacity at un-signalized intersection is measured with two methods. First approach consists of Gap Acceptance Procedure (GAP). Second approach consists of

Empirical Regression method. GAP method mostly used in United States and European Countries which is based on Critical-Gap acceptance and Follow-up times of vehicles from the minor road. Third approach is the conflict technique with pragmatically simplified concept where the interaction and impact between flows/streams from each approaches of intersection was based on the mathematical formulation.

Fig. 1 : Site view of Qamarwari junction

II. Objective and Scope Of Study

I.   To study the different traffic parameters for conflict technique by using HCM method.
II. To identify the traffic conflicts in a Major & Minor Streams in a particular intersection or junction.
III. To know the priorities an intersection/junction by using Mathematical Model.

In simple words the main part of this study is to find the capacity of this un-signalised T-intersection using conflict technique and the results would be compared with HCM (2000) procedure, which is based on gap acceptance procedure.
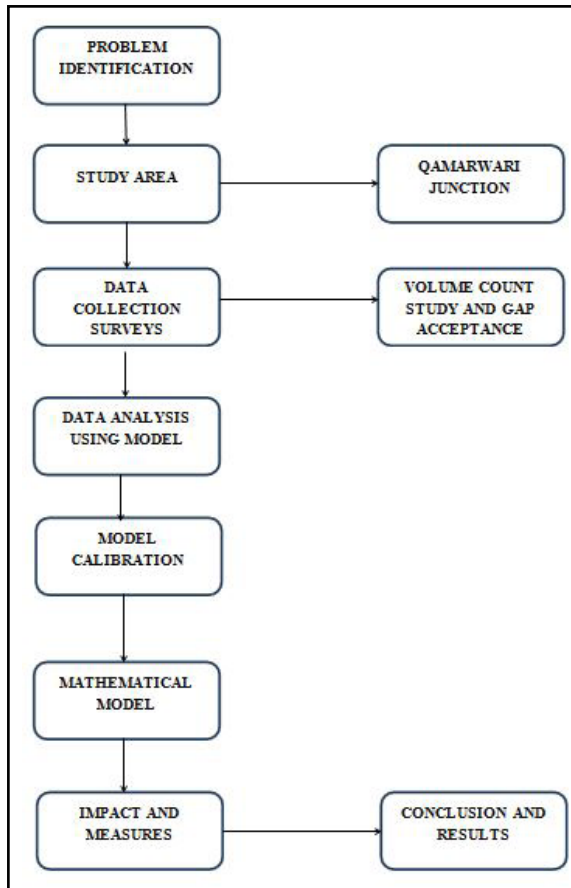
III. Methodology

Fig 2 : Showing Methodology

IV. Data Collection And Analysis

The study of traffic behaviour is useful for traffic engineers to design intersections, for developing traffic control warrants, traffic signal timings, to design the vehicle storage lanes. Data is needed for analysis and understanding of the traffic conditions. The data can be collected by manual method.

This method employs a field team to record traffic volume on the prescribed record sheets. By this method it is possible to obtain data which cannot be collected by mechanical counters, such as vehicle classification, turning movements and counts where the loading conditions or No. of occupants are required. By selecting typical short count periods, the traffic volume study is made by manual counting. Manual counts are typically used for periods of less than a day. Normal intervals for a manual count are 5, 10, or 15 minutes. Then by statistical analysis the peak hourly traffic volumes as well as the average daily traffic volumes are calculated. This method is very commonly adopted due to specific advantages over other methods.

The main objective of this study is to find the capacity of this un-signalized T-intersection using conflict technique and to compare the results with the HCM (2000) procedure, which is based on the gap acceptance procedure. For this the following field observations are necessary:
I.   Travelled distance for each movement on each approach.
II. Times of arrival and departure at reference lines for each vehicle from each stream.
III. Approach speed of the vehicles.
IV. Volume at this T-intersection movement-wise.

Manual Counts are typically used where,
I.   Small data samples are required.
II. Automatic equipment is not available, or the effort and expense of using automated equipment are not justified.
III. The count period is less than a day.

Manual counts are typically used to gather data about the following:
I.   Turning movements.
II. Direction of move.
III. Pedestrian actions.
The number of people need to collect data depends on the length of the count period, type of data being collected, number of lanes or cross walks being observed, and traffic volume.
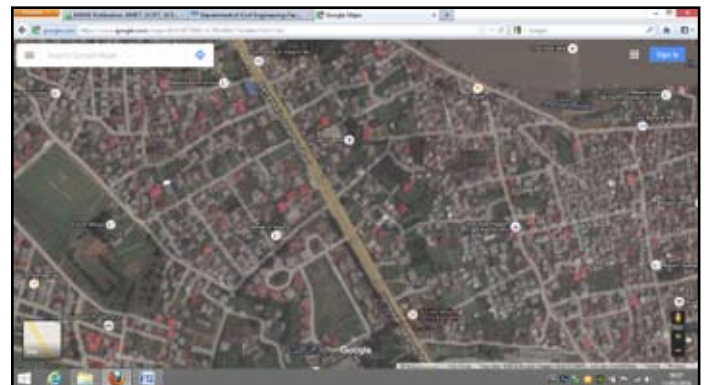
A. Study Area

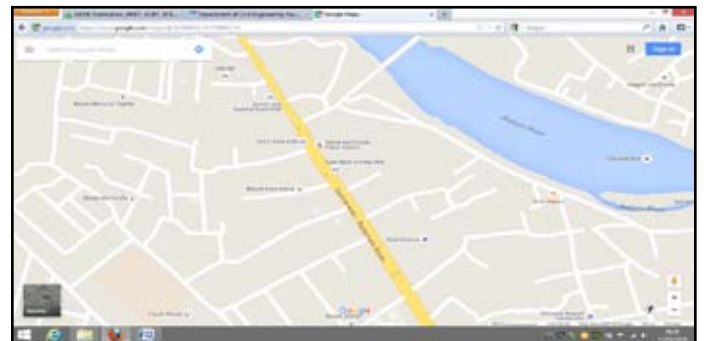Fig 3 : Aerial view of Qamarwari Chowk T-intersection (source: Google maps)

Fig. 4 : Map showing Qamarwari chowk

B. Volume Count Study

To determine the number, movement and classification of roadway vehicles at a given location, the number of observers needed to count the vehicles depends upon the number of lanes in the highway on which the count is to be taken and the type of information desired. The indications in table can be used as rough guides. It is perhaps more desirable to record traffic in each of travel separately and past separate observer for each direction enumerators should be literate persons with preferably middle or matriculation level for the purpose.

C. Gap Acceptance Study

Pedestrians preparing to cross the roadway must access the gaps in conflicting traffic determine whether sufficient length is available for crossing & decide to cross the road. Following experiments presents a method for collecting field data to identify the minimum usable gap. As if any traffic engineering analysis recognition &

definition of the difference between the standard values of the observed values & the observed values increase the accuracy.

D. Gap Acceptance Capacity Model

This method is based on critical gap acceptance and follow up times of vehicles from the minor road. The theory of gap-acceptance is the major concept for un-signalized intersection analysis. The modified Tanner's formula was found to be the most suitable model. Tanner proposed a theoretical model to relate the various parameters connected with the delay problem in dealing with an Intersection of a Major and Minor road and for finding capacity at un-signalized intersections and the expression is as follows:

$$C_p = \frac{q_M(1 - \lambda t_p)e^{-\lambda(t_c - t_p)}}{1 - e^{-\lambda t_f}}$$

Where,

$\lambda = q_M/3600$ (veh/s)

t_p = minimum headway in the major traffic stream

t_c = critical gap

q_M = number of major stream headway

t_f = follow-up gap respectively

Table No. 1 : Comparison of peak hour traffic variations at Qararwari junction

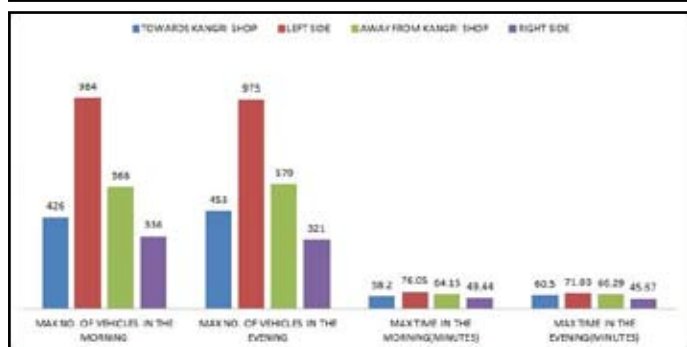| NAME OF JUNCTION	CONFLICT	MAXIMUM NUMBER OF VEHICLES		MAXIMUM VALUES OF CAPACITY	
		MORNING	EVENING	MORNING	EVENING
QAMARWARI	TOWARDS KANGRI SHOP	426	453	58.2	60.5
	LEFT SIDE	984	975	76.05	71.03
	AWAY FROM KANGRI SHOP	568	579	64.15	66.29
	RIGHT SIDE	336	321	49.44	45.67

Fig. 5 : Bar chart corresponding to table 1

V. Conclusions & Recommendations

1. Based on the traffic flow measurements, the maximum flow of a stream, the total capacity of an intersection can be calculated.
2. The data like Volume, Flow, and Capacity of each type of vehicle can be obtained from the field study as for gap acceptance models.
3. The study area of Qamarwari junction has shown the mixed traffic conditions.
4. The maximum number of vehicles in the peak hour is 984 in morning in the direction from minor street left side.
5. The conflict approach is suitable to calculate the capacity

of un-signalized intersections in general under mixed traffic flow, especially for India as an alternative instead of using the Highway Capacity Manual (2000).
6. Critical gap, follow up time are calculated within the limit of HCM(2000).
7. The traffic signal should be provided at Qamarwari junction.

VI. Scope For Further Study

The present work can be extended as indicated below:

1. Pedestrians are not considered in this study, further study can be focused on pedestrian movements along with vehicle movements.
2. It was recommended to extend the study for more than two hours and the speed can be counted in order to achieve a better prediction.

The equation used for T-junctions and the same can also be used for four-legged intersections which gives more accuracy in data analysis.

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