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Analysis on Capacity of Unsignalized T-Intersections using Conflict Technique

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***Abstract*— Urban transportation has become a chaos in these days particularly, in India carry different types of vehicles like high speed automobiles, low speed cycles, cycle rickshaws and animal drawn carts. Unsignalized intersections are the key elements in urban streets and in rural road networks. The methodology for this study of unsignalized intersections has been established where homogeneous traffic conditions are dominated. This work is mainly focused on studying the capacity of Unsignalized intersection was calculated from Conflict technique. Different traffic Surveys were conducted in Visakhapatnam, to measure different traffic parameters such as volume, flow & capacity to this method. Movements of capacity were evaluated by HCM by comparison with approach wise capacities obtained from conflict technique.**

Keywords*— Unsignalized T-Intersection, Traffic Surveys, Traffic Parameters, Capacity, Conflict Technique

I. INTRODUCTION

An intersection is a node, and usually it is a block of traffic flow in highway network. Capacity of an intersection affects the total capacity of highway network due to all types of turning movements. For actions of conflicting, merging and diverging caused by traffic flow, the traffic characteristics of intersection are more complex than those of road mid block section. Traffic stream in developing countries comprises of different types of motorized and non-motorized vehicles leads to mixed traffic conditions and lane changing patterns.Maintaining the Integrity of the Specifications.

The traffic plying on roads in western countries is of characteristics of different vehicles with marginal variation contrary to large variation on Indian roads. This will result in increased interactions between vehicles; then they tend to move in clusters rather than one after the other. Further two or three wheelers such as scooters, cycles, and cycle rickshaws contribute to this because of their easy maneuverability.

The traffic on Indian roads consists of bi-directional freedom traffic 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 turn right 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. Under these conditions, capacity of an Unsignalized intersection is difficult to be determined and becomes a very interesting field of highway capacity study. There are several types of capacity analysis models for Unsignalized intersections. The third approach is the conflict technique which was based on the mathematical formulation of interaction and impact between flows at an intersection.

a) Types of Intersection Control

A. Stop and Yield sign control Intersections

B. Signalized Intersections

C. Roundabouts

The normal practice of selecting a particular control at any intersection is based on arbitrary considerations. Normally signalization is adopted when all approaches have equal priority and vehicular delays are of higher order. Manual control is adopted at priority type intersections where a minor road meets a major road or at three legged junctions where the flow on minor road has to merge with that on major road. At some intersections, no control is adopted due to low volume levels and non-availability of resources. However, due to variations in traffic flow it is quite unclear to evaluate the traffic flow by simple observation. There is an absolute need for rational approach in this regard.

b) TYPES OF UNSIGNALIZED INTERSECTIONS

There are three types of unsignalized intersections including

- Two-way stop-controlled (TWSC)
- All-way stop-controlled (AWSC)
- Roundabouts

At TWSC intersections, the stop-controlled approaches are referred to as the minor street approaches, and can be either public streets or private driveways. The intersection approaches that are not controlled by stop signs are referred to as the major street approaches. A three-legged intersection is considered to be a standard type of TWSC intersection if the single minor street approach (i.e., the stem of the T configuration) is controlled by a stop sign. AWSC intersections require that every vehicle stop at the intersection before proceeding. Since each driver must stop, the judgment as to whether to proceed into the intersection is a function of traffic conditions on the other approaches. If there is no traffic present on other approaches a driver can precede immediately after the stop is made. If there is traffic on one or more of the other approaches, a driver proceeds only after determining that there are no vehicles currently in the intersection and that it is their turn to proceed.

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Gap-acceptance procedures (GAP) are used in many countries of the world such as in the USA. Also other countries, like Sweden, use the GAP method in their own capacity manuals. Thus it is correct to say that the theory of gap-acceptance is the predominant concept for Unsignalized intersection analysis in the world.

c) OBJECTIVES OF THE STUDY

The main objectives of the study area:

1) To determine the different traffic points of conflict technique by using HCM method.
2) To measure the traffic conflicts in major & minor streams in a particular intersection/junction.
3) To identify the priorities of a junction/intersection by using Mathematical Model.

d) CONFLICTING TECHNIQUE

Different methods to analyze the capacity at unsignalized intersections are suitable for traffic characteristics prevail in developed countries and these are not applicable for countries like India due to mixed traffic conditions. HCM (2000) is unable to model the behaviour such as of very short gap acceptance (less than 2 seconds), a large number of non–motorized vehicles which have varying speeds, no lane discipline where the chances of more conflicts. Therefore, in such a case of mixed traffic flow at unsignalized intersections the capacity is difficult to measure, when the flow is not in saturated condition. Gap acceptance Method of capacity is used in the saturated traffic and difficult to apply for mixed traffic.

Evidence shows that a relationship between speed and flow was found in every case of mixed traffic at a certain segment of road. This relationship might be more complex (linear to nonlinear) if vehicles of all types (heavy, medium and light vehicles) and the percentage of slow moving vehicles were taken into account. This idea of a relationship between speed and flow was used for further experiments. Data has to be collected for speed and flow for each vehicle type in each stream.

- Identification of conflicting groups for a three leg unsignalized intersection.
- Capacity estimation by minimum of all maximum flow conflicting groups.

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 or mechanical method or photographic methods.

e) DATA REQUIREMENTS

The main objective of this study is to find the capacity of unsignalized 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.

- Travelled distance for each movement on each approach
- Times of arrival and departure at reference lines for each vehicle from each stream
- Approach speed of the vehicles
- Traffic Volume at unsignalized intersection movement-wise.

f) DATA COLLECTION METHODS

The methods available for collecting the data at the intersection are

- Manual Methods

g) MANUAL METHODS

Manual counts are typically used when

- Small data samples are required
- Automatic equipment is not available, or the effort and expense of using automated equipment are not justified.
- The count period is less than a day.

Manual counts are typically used to gather data about the following:

- Vehicle classifications
- Turning movements
- Direction of travel
- Pedestrian movements
- Vehicle occupancy

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.

h) TRAFFIC VOLUME STUDY ON A STRAIGHT ROAD

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.

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Field data sheets and summary sheets:

- When multibank hand tally counter are not available, the data in recorded conveniently by the five-dash system, where by vertical strokes are enters for the first four vehicle followed by an oblique stroke for the fifth vehicle so as to depict a total five.
- The field data sheet prescribed by the Indian road congress standard in depicted in table.
- This form is intended to last for four hours but if the hourly flow is large one four may be needed for one hour.
- The data can be summarized for each hour of the day in a form prescribed by the Indian Road Congress standard.

The data for a period of a week, as is the recommended practice in the Indian Road Congress Standard.

Calculations

$$\text{Vehicle/15 min} = \frac{totalnumberofvehiclesin}{numberofhoursx}$$

PCU / 15 min = (vehicle/15min) x equivalence factor.

$$\text{Peak hour factor} = \frac{hourlyvolume}{peakrateofflowwithinthehour}$$

1.1 GAP ACCEPTANCE STUDY

To collect field data to identify the minimum time using gap.

- Pedestrians preparing to cross the roadway must access the gaps in conflicting traffic to 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 & the observed values increase the economy.
- Before starting the gap studies, A "T-Intersection" must be identified.
- \The chosen intersection should be far from signalized intersection so that frequency and size of vehicle gaps on roadways does not get affected.
- A certain point must be chosen for data recording if sufficient affect the readability of data but must allow a complete view of area under observation.
- Care should be taken to see that the vehicle using the approach don't obstruct the view of the passing traffic on the major roadway.
- A time gap is measured from the time the last conflicting vehicle passes the intersection until the next conflicting vehicle passes.
- Conducting the study during the peak period of traffic flow should provide a greater frequency of measurable minimum usable gaps.

No. of Vehicles obtained by Time Gap Measurement obtained from the Time the last conflicting vehicle passes the intersection until the next conflicting vehicle passes during the Study of traffic flow at Urvasi Junction, Kancharpalem Junction and Gnanapuram Junction are presented.

The theory of gap-acceptance is the major concept for unsignalized intersection analysis. This method is based on critical gap acceptance and follow up times of vehicles from the minor road.

II. MODIFIED SIEGLOCH MODEL

Siegloch (1973)modified the capacity equation by assuming the major stream headways as exponentially distributed, and then the equation is given as:

$$C = \frac{3600}{t_f} \cdot e^{\frac{-q_c}{3600}\cdot\left(t_c - \frac{t_f}{2}\right)}$$

Where,
q_c = conflicting flow
t_c = critical gap
t_f= follow-up gap respectively

Time Gap Measurement at URVASI Morning T-Intersection

Name of the Jn.	Conflict	No. of Vehicles		Maximum Values of Capacity	
		Mrng Session		Mrng Session	
		1st Hour	2nd Hour	1st Hour	2nd Hour
Urvasi	Straight to Complex	184	192	33.72	24.62
	Left side	185	182	34.12	23.18
	Straight from Complex	183	207	36.15	26.19
	Right side	200	200	30.19	24.15

Time Gap Measurement at URVASI Evening T-Intersection

Name of the Jn.	Conflict	No. of Vehicles		Maximum Values of Capacity	
		Evng Session		Evening Session	
		1st Hour	2nd Hour	1st Hour	2nd Hour
Urvasi	Straight to Complex	189	186	58.07	34.63
	Left side	191	198	53.07	43.3
	Straight from Complex	192	206	53.1	48.29
	Right side	169	200	51.8	46.1

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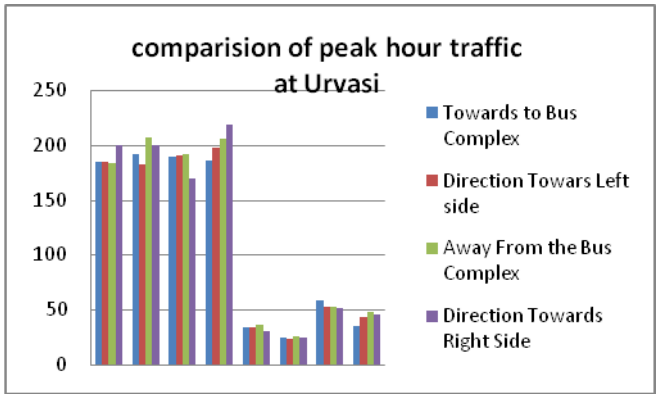
Fig Represents the Comparision of peak hour traffic at Urvasi Junction



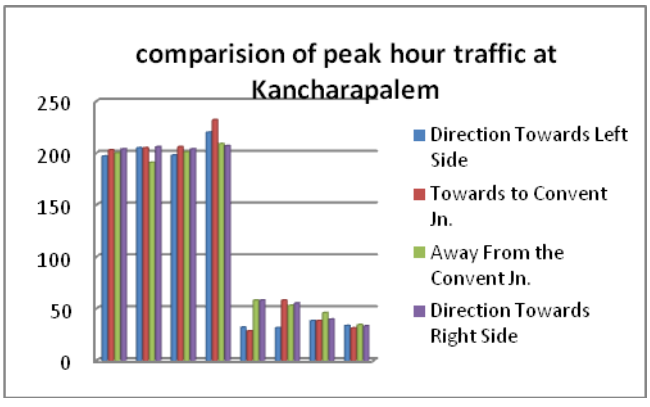
Time Gap Measurement at Kancharapalem Morning T-Intersection

Name of the Jn.	Conflict	No. of Vehicles		Maximum Values of Capacity	
		Mrng Session		Morning Session	
		1st Hour	2nd Hour	1st Hour	2nd Hour
Kancharpalem	Left Side	197	205	32	31.53
	Straight to Convent	203	205	28.4	58.18
	Straight from Convent	200	191	58.07	52.98
	Right Side	204	206	58.07	55.32

Time Gap Measurement at KANCHARAPALEM Evening T-Intersection

Name of the Jn.	Conflict	No. of Vehicles		Maximum Values of Capacity	
		Evng Session		Evening Session	
		1st Hour	2nd Hour	1st Hour	2nd Hour
Kancharpalem	Left Side	198	220	38.3	33.54
	Straight to Convent	206	232	38.3	31.26
	Straight from Convent	201	209	46.02	34.5
	Right Side	204	207	39.7	33.26

Fig Represents the Comparision of peak hour traffic at Kancharapalem Junction



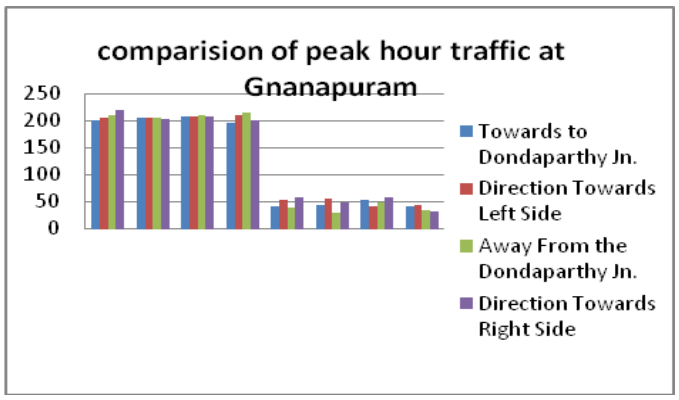
Time Gap Measurement at Gnanapuram Morning T-Intersection

Name of the Jn.	Conflict	No. of Vehicles		Maximum Values of Capacity	
		Mrng Session		Morning Session	
		1st Hour	2nd Hour	1st Hour	2nd Hour
Gnanapuram	Straight to Dondaparthy	200	206	42.45	45.67
	Left Side	206	205	54.03	56.27
	Straight from Dondaparthy	209	206	39.02	29.88
	Right Side	219	203	59.41	48.64

Time Gap Measurement at Gnanapuram Evening T-Intersection

Name of the Jn.	Conflict	No. of Vehicles		Maximum Values of Capacity	
		Evng Session		Evening Session	
		1st Hour	2nd Hour	1st Hour	2nd Hour
Gnanapuram	Straight to Dondaparthy	208	196	53.12	41.81
	Left Side	207	210	43.28	45.26
	Straight from Dondaparthy	211	215	49.72	36.42
	Right Side	208	200	58.01	33.19

Fig Represents the Comparision of peak hour traffic at Gnanapuram Junction



CONCLUSIONS

1) By Comparing all the 3 T-intersections

a) The study area of Kancharpalem Junction has shown the Mixed traffic conditions.
The maximum number of vehicles in the peak hours is 232 in the direction from Straight towards Convent Jn. to left side which is obtained in the evening hours.
b) The study area of Gnanapuram Junction has shown the Major Stream.The maximum number of vehicles in the peak hours is 215 in the direction from Minor Street to right side which is obtained in the evening hours.
c) The study area of Urvasi Junction has shown the Minor Stream. The maximum number of vehicles in the peak hours is 206 in the direction from Minor Street to right side in the morning hours and away from complex in the Major street in the evening hours.

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2) By summarizing the survey results it is came to know that the conflicts are more at Kancharpalem and Gnanapuram Junctions by providing the signals at these places will decrease the traffic conflicts.
3) The signal should be provide at Kancharpalem and Gnanapuram Junctions.
4) Critical gap, follow-up time (tc, tf) are Calculated at 3 T-Intersections and found that these are within the Limit of HCM (2000).
5) The conflict approach is suitable to calculate the capacity of unsignalized intersections under mixed traffic flow, especially for India as an alternative instead of using the Highway Capacity Manual (2000).

REFERENCES

[1] S. Siva Gowri Prasad, Ramesh Surisetty, Suresh Kumar ch "A Study on Gap-Acceptance of Unsignalized Intersections under mixed traffic conditions" IJRET by eISSN:2319-1163.
[2] Ramesh Surisetty, S. Siva Gowri Prasad "Estimation of Capacity at Un-Signalized intersections under mixed traffic flow conditions" AJER by eISSN:2320-0847
[3] Ian C. Espada, Takashi Nakatsuji and Yordphol Tanaboriboon "A Discharge Capacity Formula for Priority T-Intersection and its Application to Macroscopic Simulation of Urban Networks". J Infrastructure Plan and Man., JSCE, No.695/IV-54,177-186, January (2002).
[4] Rahim Akcelik "A Review of Gap-Acceptance Capacity Models" 29th Conference of Australian Institutes of Transport Research(CAITR 2007), University of South Australia, Adelaide, Australia, December (2007).
[5] Tian et al "Implementing the Maximum Likelihood Methodology to measure a driver's critical gap" Transportation Research, Part A, No.33 pp 187-197 (1999).
[6] Unsignalized Intersections Chapter-17 "Highway Capacity Manual (2000)".
[7] Ning Wu "Capacity of Shared-Short Lanes at Unsignalized Intersections" Transportation Research Part A 33 255-274 (1999).
[8] Ning Wu "Determination of Capacity at All-Way Stop-Controlled (AWSC) Intersections" 1710, TRB National Research Board, Washington, D.C., USA (2000).
[9] Hwang Zunhwan, Kim Jumsan and Rhee Sungmo " Development of a New Highway Capacity Estimation