Available online at www.sciencedirect.com

ScienceDirect

Transportation Research Procedia 17 (2016) 203 – 212

Transportation Research Procedia

www.elsevier.com/locate/procedia

11th Transportation Planning and Implementation Methodologies for Developing Countries, TPMDC 2014, 10-12 December 2014, Mumbai, India

Estimation of Critical Gap for Through Movement at Four Leg Uncontrolled Intersection

Akhilesh Kumar Maurya [a*], Harsh J. Amin [b], and Arvind Kumar [c]

[a] *Associate Professor, Department of Civil Engineering, Indian Institute of Technology Guwahati, Guwahati-781039, Assam, India*

[b] *Post Graduate Students, Department of Civil Engineering, Indian Institute of Technology Guwahati, Guwahati- 781039, Assam, India*

Abstract

Gap acceptance research is an important study in the estimation of capacity and delay of the specific moment at uncontrolled intersections, and critical gap is one of the primary attributes connected with this study. This attribute is a stochastically distributed value, and it cannot be evaluated directly on the field as it varies with driver, time, intersections, movements and traffic conditions. There are many studies about evaluating the critical gap have been brought out in last two decades. However, the majority of them has been brought out in developed countries where traffic condition is uniform, and rules of priorities, as well as lane regulations, are willingly followed. In India, no one obeys these types of priority rules and consequently generate more complexities on cross-roads. In spite of these conditions in India, very limited studies have been reported in such studies. This paper presents a study of crossing behavior of the driver on uncontrolled intersections. In order to investigate the crossing behavior of the driver, four-legged uncontrolled intersection located in semi-urban area of Ahmedabad in the state of Gujarat was chosen. Video recording system was employed for data gathering, and five video cameras had been utilized concurrently to collect the numerous vehicle movements on different approaches of this intersection. Succeeding, the collected videos are used to extract all the needed parameters like vehicle arrival rate/time, gap/lag time, speed and approaching vehicle types, waiting time, etc. Several existing approaches are employed to estimate the critical gap for through movements from a minor road. Gaps are explained for three different vehicle types (like Car, three wheelers, and two wheelers). A comparison between different existing methods of critical gap determination is carried out, and their critical analysis is performed.

Peer-review under responsibility of the Department of Civil Engineering, Indian Institute of Technology Bombay

Keywords: Uncontrolled intersection, critical gap, gap acceptance, mixed traffic, unsignalized intersection, driving behavior

1. Introduction

The capacity of unsignalised intersection performs an important role in the evaluation of the road network capacity. In the case of semi-urban and urban scenario, unsignalized intersections are the prime areas of traffic accidents, obstruction and clogging. Accounting, financial criteria, it is not practicable to fit the signals at every unsignalized junction to diminish

* Corresponding author. Tel.: +91-361-258 2426; fax: +91-361-258 2440.
E-mail address: maurya@iitg.ernet.in

Peer-review under responsibility of the Department of Civil Engineering, Indian Institute of Technology Bombay
doi:10.1016/j.trpro.2016.11.076

the jams and accidents. Hence in India, traffic signals are fixed only on main arteries. However, in developed countries, unsignalized intersections are commonly managed by stop and yield signs, which determine the preferences for movements at intersections. Practical implementations of these signs have produced it achievable to pass the intersections with least conflicts. However, in India, the circumstances are contradictory. Majority of junctions does not have those stops and yield signs. Though they exist, drivers don't obey those assigned symbols and enter inside junction's area even approaching vehicle is about to clash. As the majority of the movements of these non-standard intersections are not regulated, it can be named as uncontrolled intersections.

The capacity and service times at secondary streets of uncontrolled intersections rely upon the opportunities to possess adequate gap between vehicles of the upper prioritized streams to pass the conflict spaces securely. These opportunities may be a function of vehicle flow rate on the primary streams, individual drivers' as well as vehicle features that demonstrate each gap acceptance behavior. Before initiating the foundation of the critical gap, the word of gaps ought to be illustrated. Diverse articles have described the gap in distinct manners. Ashworth and Green (1966) estimated gap from the front of pursuing vehicle to rear of the first vehicle. Polus (1983) described it as the time interval between two consecutive vehicles in road stream. Highway capacity manual (2000) interpreted it as the time, in seconds, from the front bumper of the second of two successive vehicles to reach the starting point of the front bumper of the first. Although numerous investigations have recognized both gap and headway as the same, headway is the time interval between front bumpers of the vehicle to the front bumpers of pursuing vehicle. In conjunction with the term of gap comes another term lag. It is explained as the time interval between the arrivals of vehicles at a stop line of secondary stream and arrivals of the first vehicle at upstream side of the conflicts zone.

Gap acceptance is necessary objective features of the performance of the driver, and it is relevance in analyzing about capacities, delays, and road safety at uncontrolled intersections. HCM (2000) represented the gap acceptance as the manner by which a secondary road vehicle accept an accessible gap to achieve his/her movement. Critical gap is one of the leading primary parameter allied with this study. It interpreted as the least time between consecutive mainstream vehicles, in which secondary road vehicle can perform the movement (HCM, 2000). The gap size demanded by the secondary street drivers rely upon the velocity and volume of the main street traffic, sight range, several maneuvers, number of lanes on the main road, waiting time, as well as both vehicle's and driver's features. Hence, a critical gap cannot be predictable directly in the field. Separate articles described the term of the critical gap in the distinct way with a significant correction over a year. Greenshield (1947) interpreted it as a gap is selected by half of the drivers the ''minimum acceptable gap''. According to Kyte et al. (1994), it is the smallest gap in the main traffic stream needed by a minor stream vehicle to merge into or travel through the major stream gap. Raff and Hart (1950) described it as the size of gaps whose number of rejected gap longer than it is equal to a number of accepted gap shorter than it. HCM (1985) defined it as the median time gap between two consecutive vehicles in the main street traffic stream that is taken by a driver in a subject movement that must pass and/or mix with the principal street flow. Evaluation of the critical gap under mixed traffic situation is more complicated than that of uniform traffic conditions.

2. Background and Literature Review

Drivers are both consistent and uniform is presumed in maximum theories that are applied for unsignalized intersections. A consistent driver is supposed to perform the similar style at all time and all similar situations. Driver is not expected to drop a gap and then subsequently take a shorter gap. For an equivalent population, every driver is predicted to play in exactly the similar way. It is foolish to suppose drivers to be consistent and uniform. The hypotheses of drivers being both consistent and uniform for either procedure are clearly not honest. Various authors have justified that the entry capacity would diminish if drivers are heterogeneous. However, if drivers are inconsistent, then the capacity would be expanded. If drivers are supposed to be both uniform and consistent unitedly, rather than more realistically inconsistent and heterogeneous, then the differences in the prediction would be negligible. As a result, the overall impression of these hypotheses is tolerable and, for easiness, consistent and uniform driver behavior is supposed in utmost theory. The great number of investigations have been published on gap taking behaviors and critical gap estimations. Still, maximum of them have been brought in advanced countries. Some evaluation models have been explained in the literature to define the critical gap as closely as achievable. It has been observed that gap taking behavior of the driver is influenced by various characters as follows: driver's features, such as level of literacy and level of awareness with the area, the capacity to