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Enhancing Pedestrian Safety and Traffic Efficiency at Signalized Intersections-A Global Perspective

Nasar Ali Razack [a], Parul Bansal [b], Abarar A. Khalak[c]

[a] Lecturer, Department of Civil Engineering, College of Engineering & Technology, Samara University, Ethiopia, East Africa, nasar.ali01@su.edu.et
[b]Assistant Professor, CED, PIT, Parul University, Vadodara, Gujarat, India, parul.bansal8856@paruluniversity.ac.in
[c]Assistant Professor, Department of Civil Engineering, Grow More Faculty of Engineering, Himatnagar, Gujarat, India.383001.erabk111@gmail.com

ABSTRACT:

This paper provides a comprehensive overview of strategies aimed at enhancing pedestrian safety and traffic efficiency at signalized intersections from a global perspective. The study examines various measures and technologies that can be implemented to improve the interaction between pedestrians and vehicles at intersections. Additionally, it discusses the importance of considering different cultural and urban contexts when designing solutions for safer and more efficient traffic flow. By analysing best practices and case studies from around the world, this paper offers valuable insights for policymakers, urban planners, and transportation engineers working towards creating safer and more sustainable urban environments.

Keywords: Traffic Volume, Signalized Intersections, Delay, Saturation Flow

INTRODUCTION

The chapter 7 - Operational Analysis Methods of Signalized Intersections: Informational Guide, delves into tools and procedures for assessing the operational performance of signalized intersections. It emphasizes the importance of evaluating operational performance alongside safety performance when considering intersection treatments. The chapter categorizes operational analysis into four levels, ranging from rules of thumb for intersection sizing to microscopic simulation models, each varying in complexity and application difficulty. The text highlights the significance of traffic operations analysis in diagnosing issues and selecting suitable treatments for signalized intersections. Key measures of effectiveness discussed include capacity and volume-to-capacity ratio, delay, and queue, which are essential for evaluating signalized intersection operations. Figure 1 shows increasing safety and efficiency at intersections.

Figure 1. Increasing Safety and Efficiency at Intersections (source: Google Image)

The chapter also mentions various international capacity analysis procedures and software tools used for estimating performance measures at the lane level. Table 1 shows HCM Delay LOS Criteria for Signalized Intersections.

* Corresponding author. Tel.: +91-6351638575
E-mail address: abrar.khalak.civil@growmore.ac.in

LOS	Average Control Delay (sec/veh)
A	10
B	> 10 and 20
C	> 20 and 35
D	> 35 and 55
E	> 55 and 80
F	> 80

Table 1. HCM Delay LOS Criteria for Signalized Intersections

LITERATURE REVIEW

Jacek Oskarbski et. Al. analysed signalized intersections in the context of pedestrian traffic in Gdynia, Poland. The study aimed to find solutions that improve pedestrian walking and safety conditions at these intersections. The research considers factors such as pedestrian speed, traffic incidents, and simulations using the VISSIM software. The analysis highlights the need for solutions to address the high pedestrian fatality rate in Poland and the lack of pedestrian-friendly infrastructure. Pedestrian speed at signalized intersections can be influenced by various factors, including age, gender, physical constitution, motivation and purpose of travel, distance to be covered, and weather and terrain conditions. Research has shown that older individuals tend to have slower speeds compared to younger individuals. In a study conducted in New York City, it was observed that 78% of pedestrians moved at speeds less than 1.4 m/sec, with a median speed of 1.2 m/sec. Additionally, factors such as the design of the intersection, traffic control logic, and pedestrian behaviour also play a significant role in determining pedestrian speed.

Hadeel Mundher et. al. focused on the influence of driver behaviour on the saturation flow rate at signalized intersections. The study aims to measure the impact of driver behaviour on the saturation flow rate by comparing the actual field saturation flow rate with the ideal saturation flow rate. The results indicated that non-aggressive (conservative) driver behaviour increases the saturation headway and reduces the saturation flow rate, while aggressive driver behaviour reduces the saturation headway and increases the saturation flow rate. The study also highlights the dependence of saturation flow rate on locality, with driver behaviour playing a significant role. Driver behaviour directly influences the saturation flow rate at signalized intersections. Non-aggressive (conservative) behaviour increases the saturation headway and reduces the saturation flow rate, while aggressive behaviour reduces the saturation headway and increases the saturation flow rate.

Shaikh Nazneen Mushtaq et. al. presented a literature review on saturation flow at signalized intersections under mixed traffic flow conditions. Saturation flow is an important parameter for estimating signal green time and determining the capacity of signalized intersections. The study examines different methods of calculating saturation flow volume and their accuracy. It also discusses the effect of various factors such as vehicle type, lane width, grade, and area type on saturation flow. The review concludes that the traditional empirical formula for estimating saturation flow may not be appropriate for Indian conditions and suggests using the calibrated US-HCM 2000 model instead.

The significant parameters in the planning, design, and control of signalized intersections include saturation flows, lost times, and Passenger Car Units (PCU). Saturation flow is crucial for estimating signal green time and determining the capacity of signalized intersections. Lost times refer to the time during which the intersection is not effectively used by any movement, such as during change intervals or at the beginning of each phase. PCU values are important for measuring traffic conditions prevailing in developing countries and are used to estimate saturation flow rates. Saturation flow rate at signalized intersections is defined as the maximum discharge rate during green time. It is the maximum volume, stated in passenger car units per hour (PCU/h), that can pass through the stop line of an approach lane at a green light with a queue of vehicles. Saturation flow is crucial for estimating signal green time and determining the capacity of signalized intersections. The measurement of saturation flow involves considering factors such as lane width, heavy vehicles, approach grade, parking activity, area type, lane utilization, turning movements, and pedestrian factors. Various studies have explored different methods to calculate saturation flow volume and its accuracy, highlighting the importance of including intersection passing speed in assessments to reflect actual traffic conditions.

Nadika Jayasooriya and Saman Bandara focused on establishing guidelines for phase sequencing in traffic signal designs when a dedicated right turn lane is not available. By examining different phasing arrangements for right turns, such as total through plus right turn phase, leading green for right turns only phase, and lagging green for right turns only phase, the study aims to minimize delays. By applying Webster's theoretical framework for

traffic signals and delay estimations, the research successfully achieved cycle time reductions and corresponding delay reductions. Additionally, a traffic microsimulation using VISSIM software was conducted for further analysis and validation. The study found that the leading green for right turns only phase is effective when the right turn percentage is below 15%. By carefully selecting phasing arrangements based on varying traffic volumes and right turn percentages, significant delay reductions can be achieved.

3. CONCLUSION

Research has revealed that pedestrian speed at signalized intersections is influenced by various factors, including age, gender, physical constitution, motivation, distance to be covered, and weather conditions. Older individuals tend to have slower speeds compared to younger individuals. Parameters such as saturation flows, lost times, and Passenger Car Units (PCU) are significant in the planning, design, and control of signalized intersections. Saturation flow rate, crucial for estimating signal green time and determining capacity, is influenced by factors like lane width, heavy vehicles, approach grade, parking activity, and pedestrian factors. It is essential to consider various factors in calculating saturation flow volume accurately, including intersection passing speed, to reflect actual traffic conditions effectively. The measurement of saturation flow plays a vital role in optimizing signal green time and improving the efficiency of signalized intersections

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