Proceedings of the 2nd World Congress on Civil, Structural, and Environmental Engineering (CSEE'17)
Barcelona, Spain – April 2 – 4, 2017
Paper No. ICTE 112
ISSN: 2371-5294
DOI: 10.11159/icte17.112

Warranting a Permissive Left Turn Phase by Time of Day for Flashing Yellow Arrow (FYA) Signals

Hatem Abou-Senna, Essam Radwan
University of Central Florida
4000 Central Florida Blvd., Orlando, Florida, USA
hatem.abou-senna@ucf.edu, ahmed.radwan@ucf.edu

Extended Abstract

The most critical aspect of signal design and timing at an intersection is the development of an appropriate phase plan, which is mainly driven by left turn treatments. Accommodating and addressing left-turn vehicles is challenging for traffic engineers as they seek balance between intersection capacity and safety; these are two conflicting goals in the operation of a signalized intersection that are mitigated through signal phasing techniques.

The traditional PPLT signal head has been a five-section configuration with a circular green (CG) indication for both permissive left turns and through traffic. While PPLT configurations allow most left-turning traffic to turn during the protected phase, the permitted phase exploits the efficiency of using available gaps in oncoming traffic to facilitate additional left turns. However, in many cases, concerns arise with left turning traffic patterns during certain times of day, such as heavy pedestrian activity especially during school arrival and dismissal. When such concerns arise, engineers need to modify the signal from protected/permitted (PP) phasing to protected-only (PO) by changing the signal displays. Historically, this change required physical replacement of overhead signal displays and was essentially a permanent change, even though it may only be needed a few hours per day.

The use of a four-section head for the left-turn-only lane with a flashing yellow arrow (FYA) indication for permissive left turns overcomes this limitation. The FYA has been deemed to be the new standard for signalization as recommended in the 2009 MUTCD. FYA treatments at intersections are considered new and evolving fast especially in the Central Florida area. With the advent of this new signal configuration, there was the opportunity to take the protected-permitted left-turn mode to a new level of operation. The new all-arrow configuration provides the opportunity to change the operation mode at any time during the day from fully protected to completely permissive or combinations of both.

Though numerous studies have developed guidelines for selecting left-turn control types, to date, there are no clear or uniform standards for the selection of left-turn phasing mode changing by time of day. From the literature review, it was found that common guidelines for left-turn phasing did not apply to all intersections. A comprehensive approach was needed to cover all cases and to develop a deeper understanding of the range of parameters that affect left-turn phasing for efficient operation while maintaining safety. Combining the two aspects is rarely achieved.

A list of candidate parameters related to "Traffic, Safety, Signal, Geometry and Land-Use", was developed to determine the operational and safety impact measures of effectiveness (MOEs) for left turns. These parameters represented the basis of the interactive framework to evaluate the suitable left-turn mode under different time-of-day volume levels.

The current study developed an interactive decision support system (IDSS) for the selection of left turn phasing mode by time of day. Standard experimental designs either using full factorial or fractional factorial did not fit the research requirements, and therefore a novel optimal custom design approach was selected for this research. The resulting model predicts the number of left turns during the permissive phase under different intersection conditions and assesses the operational and safety aspects of warranting a permitted left-turn phase based on specific criteria and thresholds; comparing the amount of permissive green time given throughout the hour with the number of permissive lefts determine whether the opposing traffic flow was operating near or at saturation. The developed guidelines would provide traffic engineers with the tools to utilize the efficiency of the permissive left turn phase. Furthermore, the developed DSS provides an interactive evaluation of left-turn phasing and ultimately recommend phasing mode by time-of-day which will assist Traffic Management Center (TMC) personnel to identify intersections requiring attention/modification of left turn mode.