

PERMISSIVE/PROTECTED LEFT-TURN PHASING CAN IMPROVE SAFETY AT SIGNALIZED INTERSECTIONS

INTRODUCTION

Left-turning movements are generally acknowledged to be the highest-risk movements at intersections. An estimated 27 percent of all intersection-related crashes in the United States are associated with left turns, with over two-thirds of these crashes occurring at signalized intersections¹. Vehicles making this type of movement encounter potential conflicts from several sources including opposing through traffic, through traffic in the same direction, and crossing vehicular and pedestrian traffic. Research also demonstrates that the number and severity of crashes can be reduced by using simple, low-cost enhancements such as modifying the permissive left-turn signal mode to a permissive/protected mode to reduce the number of driver conflicts. The experience of Detroit and Grand Rapids, Michigan, demonstrates how transportation agencies can improve safety with this low-cost enhancement.

These cities were concerned about the high number of crashes at some of their signalized intersections. Recognizing that conflicts occurring in the course of the left-turn movement during the permissive left-turn phase can cause crashes, the cities modified the permissive left-turn mode to a permissive/protected mode at 3 intersections experiencing a high incidence of crashes, many with injuries and many due to left-turn head-on crashes². The crash reduction averages in this report reflect the average percent reduction per year based on the difference between the total number of "before" and "after" crashes, observed over a minimum duration of 2.5 years at each intersection, between 1988 - 2002. The "before" and "after" observation periods ranged between 6-29 months depending on the intersection.

LOW-COST IMPROVEMENTS

This article summarizes the effects of the addition of a permissive/protected left-turn mode that reduced crashes at signalized intersections. The speed limits at the treated intersections ranged from 30-35 mph. Officials also retimed signals as appropriate to accommodate the permissive/protected left-turn phasing. The three signalized intersections are described below.

1) Wyoming Road and Seven Mile Road, Detroit, MI

Detroit replaced existing permissive left-turn phasing with permissive/protected left-turn mode on the Wyoming Road approaches. **This relatively inexpensive treatment has proven effective in reducing crashes, and the city experienced an average crash reduction of 27.8 percent and injury crash reduction of 54 percent per year at these intersections. Left-turn head-on crashes were eliminated.**

2) Eastern Avenue and Alger Street, Grand Rapids, MI

Grand Rapids replaced existing permissive left-turn phasing with permissive/protected left-turn mode on the Eastern Avenue approaches. **Installing this simple, low-cost countermeasure reduced total crashes by 10.6 percent and reduced injury crashes by 100 percent per year. Left-turn head-on crashes were eliminated.**

¹ O'Connor, T., "Intersection Collision Avoidance Systems Web Page," California Center for Innovative Transportation, August 2004. (http://www.calccit.org/itsdecision/serv_and_tech/Collision_avoidance/intersection.html).

² Existing intersections met minimum Manual on Uniform Traffic Control Devices (MUTCD) standards.

3) Burton Street and Kalamazoo Avenue, Grand Rapids, MI

Grand Rapids replaced existing Burton Street permissive left-turn phasing with permissive/protected left-turn mode (Figure 1). Additional permissive/protected left-turn phasing was installed on Kalamazoo Avenue. Grand Rapids realized an average crash reduction of 44.7 percent and injury crash reduction of 56.8 percent per year at these intersections. Left-turn head-on crashes were reduced by 65 percent per year.

The Cost of Improved Safety

The cities had no implementation issues with this countermeasure and the costs for implementing the enhancements were low: approximately \$25,000 per intersection. The signal mode improvements at each intersection were implemented within one week.

The enhanced countermeasure installed at these signalized intersections cumulatively reduced total crashes by approximately 32 percent, injury crashes by 58.9 percent, and left-turn head-on crashes by an average of 84 percent per year.

As the Michigan experience demonstrates, low-cost improvements can effectively improve safety and reduce traffic crashes and their resulting injuries. For more detailed data and results on this success story and other proven intersection safety treatments from across the country, please see the following website: <http://safety.fhwa.dot.gov/intersection>. For more information, contact Ed Rice, Intersection Safety Team Leader, FHWA Office of Safety (ed.rice@dot.gov), or Tapan Datta, WSU-Transportation Research Group, MI (tdatta@eng.wayne.edu).

Figure 1 (photos courtesy Michigan DOT [used with permission]):
Burton Street and Kalamazoo Avenue Intersection, Grand Rapids, MI



“Before” Condition



“After” Condition

OPTIONAL FIGURES:



Photo by April Armstrong (used with permission).

Photos courtesy Michigan DOT (used with permission):



Permissive/Protected Mode