Ohio Department of Transportation Research Project Fact Sheet

Evaluation of Driveway Assistance Devices in Signalized Work Zones

Researcher(s)	Deborah McAvoy, Ph.D., P.E., PTOE Bhaven Naik. Ph.D., P.E., PTOE Jean Hartline, P.E., PTOE
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The Problem

When a part-width work zone requires one-way travel along a two-way corridor, driveways and low volume intersecting roads within the work zone create additional challenges. Temporary traffic signals are a proven technology that allows for 24-hour, one-way operations on two-way roads; however temporary traffic signals have limitations. In order to allow motorists to enter the mainline one-way traffic stream from a driveway in the middle of a work zone, temporary traffic signals stop mainline traffic to allow vehicles at driveways or intersecting roads to proceed and therefore must wait for the vehicle(s) to clear the one-way work zone before returning flow back to the mainline. This can cause a substantial delay for all drivers. Additional driveways require their own phasing, further increasing delay for mainline traffic if multiple calls are received at the same time.

In order to determine the feasibility for future use of DADs, the devices will be evaluated for their effectiveness in terms of traffic operation, motorist safety and worker risk in one-way, two-lane work zones with the presence of driveways within the work zone. If the DADs are proven to be a safe, efficient, and effective temporary traffic control device, inclusion in the MUTCD would allow for widespread use which could have a significant impact on user delay, safety, and construction costs.

Research Approach

An evaluation was conducted along State Route 60, in Muskingum County, Ohio as associated with ODOT's construction contract 210208, (PID 101004) to examine the performance differences between traditional temporary traffic signal devices and DAD devices at driveways in a work zone. State Route 60, a two-way two-lane roadway, as shown in Figure 1, is classified as a Rural Minor Arterial with a speed limit of 55 miles per hour in the vicinity of the project. The overall goal of this research project is to evaluate performance of the DAD devices in comparison to temporary traffic signal devices and, based on the findings, provide recommendations to ODOT on their safety, effectiveness, and cost-efficiency for adoption in signalized work zones.

Figure 1. State Route 60 Project Area

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This research was sponsored by the Ohio Department of Transportation and the Federal Highway Administration.

To accomplish the overall goal of the research of evaluating the performance of the DAD devices in comparison to the temporary traffic signals, several tasks were completed as follows:

1) Field studies were conducted to collect volume, queuing, compliance, safety and speed of vehicles within the work zone, both along the mainline as well as at the driveways.
2) Surveys were conducted to determine public and worker perception of the traffic control devices.
3) Microsimulation Analyses were conducted to compare operational performance of the temporary traffic signals and the DADs. A sensitivity analysis was also conducted utilizing microsimulation to determine appropriate deployment metrics for the DAD devices.
4) A benefit-to-cost analysis was conducted to determine the efficacy of utilizing the DAD devices in future partial width construction utilizing one-lane, one-way traffic.

Findings

The results of the research study, including findings from the field study and the microsimulation analysis, indicate that the DAD devices provide the following benefits over the temporary traffic signal devices for driveway control:

- Reduced driveway delays
- Reduced mainline queue lengths at the end of the work zone
- Reduced mainline delays at the end of the work zone
- Improved driver compliance, especially for driveways located near the end of the work zone

The sensitivity analysis to understand the impacts of volume or signal timing changes along the network found the following:

- DAD devices for driveway control maintain driveway delays of on average less than 50 seconds per vehicle with 30 to 50 vehicles per hour utilizing the driveway.
- DAD devices for driveway control have stable time-to-collision and post-encroachment time values with 50 or fewer vehicles per hour utilizing the driveways.
- Additional mainline traffic volumes up to 5000 vehicles per day yields a maximum of 14 vehicles queuing along the mainline roadway at the end of the work zone.
- Longer red signal timings do not substantially increase queue delays at driveways.

The benefit-to-cost analysis included the calculation of several types of road user costs including the cost of driveway delay per day, travel speed cost per day, queue delay cost per day and conflict costs per day in addition to the maintenance and initial costs for the devices. As crash costs typically can sway a benefit-to-cost analysis, the benefit-to-cost ratio was determined without the conflict costs. The overall benefit-to-cost ratio only considering the device and maintenance cost was 7.6:1 whereas with the road user cost (less the conflict costs) the ratio was 153.37:1.

Recommendations

Based upon the results of the safety and microsimulation analysis, the following implementation recommendations for utilization of the DAD devices are as follows:

- Driveway locations with less than 30 to 50 vehicle per hour to keep levels of service at driveways below 50 seconds of delay.
- Mainline volumes of 5000 vehicles per day in each direction will yield a 14-vehicle queue length at the end of the work zone.
- The signal phasing should be designed to provide optimal travel flow for the mainline traffic and minimize the time allowable for the driveways as the delay at the driveways is not impacted by signal phasing.
- Straight work zone sections of roadway will have better safety outcomes than those with curvature.

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