Innovative End-of-Queue Warning System Reduces Crashes Up to 45%

Background

A Texas Department of Transportation (TxDOT) project to widen 96 miles of Interstate 35 (I-35) through central Texas has led to the design of an innovative end-of-queue warning system that reduced crashes by up to 45%.

Frequent temporary nighttime lane closures were inducing queues upstream of the merging taper. (Daytime closures were prohibited.) The queues were of concern for four reasons: 1) The corridor is predominantly rural, so drivers do not expect traffic queues, especially at night. 2) Lane closure necessity and locations vary nightly so travelers are unable to develop an expectation of queues. 3) Contractors were using all available right-of-way for construction activities, so queue warning equipment could not be easily positioned and left until needed. 4) The corridor is heavily used by large trucks, which increases the severity risk of any end-of-queue crashes.

System Concept

The end-of-queue warning system consists of two components (*see deployment diagram on reverse*):

- **Portable Work Zone Queue Detection and Warning System.** A highly-portable work zone intelligent transportation system (ITS) queue detection and warning system is deployed upstream of the merging taper on each night that queues are expected. It is removed the next morning, along with the merging taper.
- **Portable Rumble Strips.** Portable rumble strips are deployed in the travel lanes upstream of the merging taper to provide tactile, audible, and visual alerts as the driver approaches a lane closure.

(a) Rumble strip deployment

(b) Speed sensor

(c) Pre-designed portable changeable message sign (PCMS)

Two end-of-queue warning system configuration plans were developed to cover varying queue lengths. The first plan provides real-time warning of queues up to 3.5 miles long. It includes:

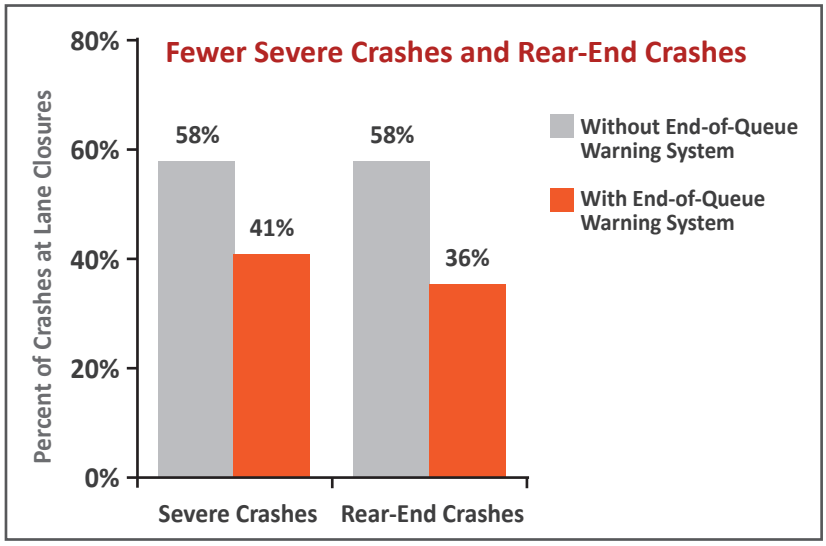
- four portable speed sensors deployed from merging taper to approximately 2.5 miles upstream,
- a single portable changeable message sign (PCMS) positioned 3.5 miles from the merging taper, and
- portable rumble strip arrays laid down beginning at 3.75 miles from the merging taper.

The second plan doubles the length of the first plan to warn of queues up to 7.5 miles long. It includes eight sensors, two PCMS, and two sets of rumble strip arrays.

Effectiveness

Experiences with system effectiveness to date:

- deployed on more than 200 nighttime lane closures in the corridor
- crashes on those nights reduced by 18 to 45 percent (compared to an estimate of what they would have been if the systems had not been deployed)
- fewer rear-end collisions and severe crashes (injury + fatal) at lane closures with the system deployed than at similar lane closures without the system
- savings of between $1.4 million and $1.8 million in societal crash costs
- ongoing savings of societal crash costs of between $6,600 and $10,000 per night of deployment.

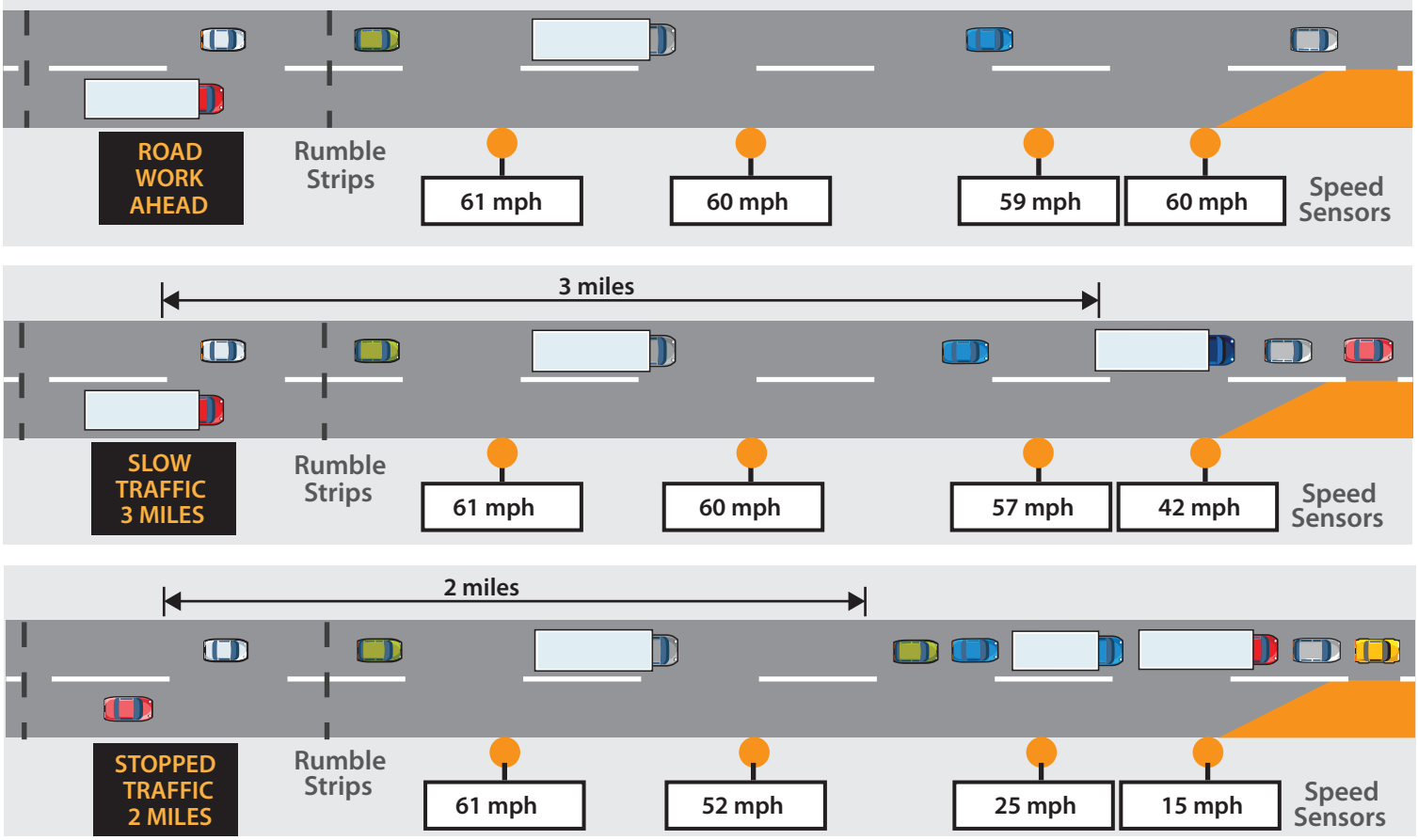


September 2015

Continued from page 1

A pre-designed PCMS message warns motorists of the presence of stopped or slowed traffic and the approximate distance to the stopped or slowed condition. The pre-designed message is selected using operational rules based on the detected speed at each sensor.

Project personnel enter planned lane closures into a database that tracks all pending closures. From that database, an input-output analysis of expected traffic volumes versus expected work zone capacity is automatically performed for each planned lane closure. If queues are projected during construction for the following evening, a deployment plan that will cover the maximum expected queue length is deployed as part of the temporary traffic control set up for the lane closure that night.



Procurement

Multiple systems were procured through the various construction contracts which comprised the 96-mile I-35 project. Systems were bid with:

- an initial mobilization cost to procure the necessary equipment, and
- a per-deployment cost for the additional staff and vehicle expenses incurred during temporary traffic control installation and removal each night.

Several of the construction contractors use the same traffic control subcontractor, who has possession of the systems. Thus, the contractors can “borrow” systems from each other if needed to cover multiple lane closures on a given night.

ARTBA Work Zone Safety Consortium

American Road and Transportation Builders Association ■ National Asphalt Pavement Association ■ International Union of Operating Engineers ■ Community College Consortium For Health and Safety Training ■ U.S. Department of Transportation Federal Highway Administration ■ Texas A&M Transportation Institute ■ FOF Communications ■ American Association of State Highway and Transportation Officials

This material is based on work supported by the Federal Highway Administration under Grant Agreement No. DTFH61-11-H-00029. Any opinions, findings and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the Federal Highway Administration. This publication does not constitute a national standard, specification, or regulation.

For more information about the use of queue warning systems: https://www.workzonesafety.org/swz/technology_application/outreach **September 2015**