Evaluation of Rural Intersection Treatments

tech transfer summary

Post-mounted stop sign beacons and retroreflective strips on stop sign posts are promising low-cost countermeasures that may help mitigate failure-to-yield crashes.

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RESEARCH PROJECT TITLE
Evaluation of Rural Intersection Treatments

SPONSORS
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The Midwest Transportation Center (MTC) is a regional University Transportation Center (UTC). Iowa State University, through its Institute for Transportation (InTrans), is the MTC lead institution.

MTC's research focus area is State of Good Repair, a key program under the 2012 federal transportation bill, the Moving Ahead for Progress in the 21st Century Act (MAP-21). MTC research focuses on data-driven performance measures of transportation infrastructure, traffic safety, and project construction.

IOWA STATE UNIVERSITY
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Objective

The objective of this research was to select promising low-cost rural intersection countermeasures and evaluate their impact on improving safety. Specifically, this research evaluated post-mounted stop sign beacons and retroreflective strips on stop sign posts.

Background and Problem Statement

Because crashes at rural intersections are frequently due to failure to yield, agencies attempt to identify countermeasures that encourage drivers to stop and yield appropriately.

Various countermeasures have been utilized to reduce crashes and improve intersection safety. However, some treatments have been shown to have mixed results, while for others only limited information about effectiveness is available.

Because even low-cost treatments require some maintenance, it is important for agencies to have information about the effectiveness of the various treatments before investing in them.

Raju Thapa, Institute for Transportation

Post-mounted stop sign beacons

Research Description

The research team and the project's technical advisory committee (TAC) selected two low-cost countermeasures for evaluation: post-mounted stop sign beacons and retroreflective strips on stop sign posts. The post-mounted beacons included radar so that the systems could be set to only activate when an approaching vehicle's speed surpassed a predetermined threshold.

High-crash rural stop-controlled intersections were identified using in-house crash and roadway data and then filtered for suitability via site visits. The post-mounted beacons were installed on stop signs at 10 approaches at 6 intersections. The retroreflective strips were installed on stop signs at 14 intersections on both of their minor street approaches.

While the ideal metric for evaluating the safety impacts of a countermeasure is to evaluate crashes before and after installation, this requires several years of post-installation crash data. To perform a short-term evaluation, driver behavior was used to assess the countermeasures.

Because the post-mounted beacons were expected to noticeably impact driver behavior while the retroreflective strips were not, driver behavior data were only collected at 10 approaches where post-mounted beacons were installed:

- North and south approaches at intersections in Benton, Clay, and Dallas counties
- East and west approaches at an intersection in Buena Vista County
- West approach at intersections in Sioux and Johnson counties

Video data were collected using trailer-mounted cameras at these 10 approaches 1 month before and 1 month after installation. For 6 of the 10 approaches, data were also collected 12 months after installation.

Several driver behavior metrics, including type of stop, stopping position, point at which drivers first began braking, and number of times braking, were reduced by the researchers for a random sample of vehicles for each approach in each evaluation period and compared before and after installation.

The use of retroreflective strips on stop sign posts is expected to increase sign conspicuity, particularly at night, which will ideally result in fewer crashes. However, video data were not collected for this countermeasure because it was not expected to measurably affect driving behaviors such as braking point and because reduction of nighttime video is especially challenging.

Theresa Litteral, Institute for Transportation

Nighttime view of retroreflective strips

Key Stop Sign Beacon System Findings

The post-mounted stop sign beacon systems had an overwhelmingly positive safety benefit, as measured by several changes in driver behavior.

- One month after installation, the number of drivers coming to a full stop at the intersections increased at 9 of the 10 approaches, and the number that did not stop decreased at 5 approaches. After 12 months, the number of drivers coming to a full stop increased at 5 of 6 approaches.
- Overall, both at 1 month and 12 months after installation, the number of drivers that began braking early (450 to 500 ft of the intersection) increased while the number of drivers that first began braking within 300 ft of the intersection decreased.
- At most approaches, the number of drivers stopping at or before the stop bar increased after installation. Stop location thereby improved overall.

Video still showing brake light activation

It is not known whether braking behavior impacts safety. However, the premise for collecting the number of braking events for each driver is that drivers who brake multiple times may not be prepared for the upcoming intersection.

- The number of drivers braking only once increased at most intersection approaches 1 month after installation and, after 12 months, this number increased at all approaches. The presence of the beacons therefore had a positive impact on braking behavior.

Implementation Readiness and Benefits

The stop sign beacons were found to be a reasonably low-cost countermeasure. The cost of each beacon was approximately $3,000, plus the costs of regular maintenance. The additional expense required for the radar or other speed sensor is included in the $3,000 cost for the beacon.

The flashing beacon was speed activated so that only "problem" drivers would be targeted. Drivers may otherwise become habituated to countermeasures that they observe regularly. It was felt that the use of the targeted approach was effective. Ideally, the improvements in driver behavior will result in reduced crashes at the study intersections.

Theresa Litteral,
Institute for Transportation

Retroreflective strip installation on wooden post

For the retroreflective strips on stop sign posts, most of the approaches along two-way/two-way roadways had a single wooden or telespar post with a stop sign. The researchers intend to conduct a crash analysis when at least three years have elapsed after installation of this countermeasure.

Iowa cities and counties will be able to access the results of this research through the current Synthesis of Safety-Related Research webpage, which lists a number of countermeasures for rural intersections. Updating this page with the results of this research will add Iowa-specific information about the treatments that agencies can use to apply the results.

Additionally, the research team is working with the Iowa Local Technical Assistance Program to disseminate the results of this research to Iowa agencies.

The main benefit of this work is that the results are "shovel-ready." Using the provided background and results, agency staff can decide whether to use stop sign beacons at rural intersections.