

A slight turn

Improving retroreflectivity on curves has modest effect

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A large number of rural crashes occur on curves—some sources estimate the crash rate on curves to be three times the crash rate of tangent sections.

Curve-related crashes involve a number of roadway and driver causative factors. Driver errors on horizontal curves are often due to inappropriate selection of speed and inability to maintain lane position. Factors that contribute to excessive speed include driver inexperience, workload, sobriety, distraction, fatigue, sight distance, misperception of degree of roadway curvature and situational complexity.

As agencies attempt to improve safety, they are often looking for low-cost measures that can be applied quickly and economically. The use of several low-cost treatments—such as post-mounted delineators, on-pavement curve warning signs, raised pavement markings and wider edge lines—have been used to provide additional delineation around curves. However, the effectiveness of many of these treatments is not well understood or documented.

A study was conducted by the

Center for Transportation Research and Education (CTRE) through the Institute of Transportation at Iowa State University to evaluate low-cost strategies to reduce speeds and crashes on curves. Adding reflectorized material to the posts of existing chevrons to provide additional curve delineation and use of on-pavement curve markings are two strategies evaluated.

Dressing them up

The team compiled a list of high-crash horizontal curves (5+ crashes within five years) on rural two-lane paved roadways in Iowa. Field visits narrowed sites to those where an actual speeding problem existed, no major maintenance or safety treatment had been applied in the last three years or was scheduled for the next three years, and no unusual features that would make certain types of treatment or speed data collection difficult existed. Six sites were selected.

Reflective post treatments were added to the posts of existing chevrons at four curves. The post treatment adds delineation to reinforce the presence of a curve to drivers and can be effective for several reasons. First, it draws attention to the curve so that drivers who did not receive other cues are able to detect the curve. Second, it can help drivers

Table 1. Crash Site Characteristics

Site	AADT (vpd)	Posted Speed Limit	Curve Advisory Speed	Treatment
US 52	2,280	50	40	Retroreflective post treatment
CR Y52	1,710	55	40	Retroreflective post treatment
221st Street	2,410	55	50	Retroreflective post treatment
IA 141	830	55	35	Retroreflective post treatment
DMC 99	780	55	none	On-pavement curve signs
CR L20	1,880	55	35	On-pavement curve signs

determine where lane boundaries are at night or periods of limited visibility, such as rain or snow events. Delineation also can help drivers gauge the sharpness of a curve so they can adjust their speed and lane position accordingly. Use of the additional retroreflective material is a supplementary treatment to existing chevron posts.

Retroreflective strips were added to the front and back of existing wood chevron posts facing both directions on U.S. 52, 221st Street and Iowa S.R. 141. A 60-in. polypropylene tube coated with yellow high-intensity sheeting was wrapped around existing Telspar chevron posts at Y-52.

On-pavement curve signs were used at two different curves. Several variations on this treatment have been applied and include use of on-pavement curve arrows, text such as “SLOW DOWN,” the curve advisory speed or posted speed limit. For this study, a curve arrow and the text “SLOW” were framed by two horizontal bars. The markings were placed approximately 400 ft after the corresponding standard curve warning signs before the point of curvature (PC). Treatments were added for both directions of travel into the curve.

Checking your speed

Speed data were collected before and after installation of each treatment using pneumatic road tubes. Data were collected at various locations along the curve, depending on curve geometry. This typically included PC and center of curve. Data were evaluated in the direction of the vehicle entering the curve at PC locations and for both directions within the curve.

The study compared mean and 85th percentile speeds. The researchers also calculated and compared the percentage of

vehicles traveling over the posted or advisory curve speed by a certain threshold.

The study showed that the addition of retroreflective material to existing chevrons as a supplementary treatment was moderately effective in most cases. A few locations where data were collected had minor increases in mean or 85th percentile during the daytime while most locations saw decreases of 0.6 to 1.9 mph in mean speed and 1 to 2 mph for 85th percentile speed. Several locations had increases in the fraction of vehicles traveling 5 mph or more over the advisory speed or 10 mph or more over, while most locations had decreases between 2% and 50%. The majority of locations had a decrease in the fraction of vehicles traveling over the advisory speed by 15 mph or more with decreases from 1% to 33%. Most locations also had decreases for the fraction of vehicles traveling 20 mph or more over the advisory speed with decreases from 1% to 8% noted. Although it was expected that the treatment would be much more visible and therefore effective during the nighttime, speed changes were similar for the nighttime and daytime.

Use of on-pavement curve signs also was moderately effective. One of the

locations where data were collected saw no change in mean speed, while the remaining locations had decreases up to 1.8 mph. The 85th percentile speed increased slightly or remained the same at half of the locations where data were collected and decreases of 1 mph were noted at the other half. Several locations had increases in the fraction of vehicles traveling 5 mph over the posted or advisory speed while most sites had decreases from 1% to 14%. At the 10-mph-or-more threshold, one location had an increase but the remaining locations had decreases between 1% and 10%. The fraction of vehicles traveling 15, 20 mph or more over the posted or advisory speed remained unchanged or had minor increases for up to half of the locations, while the remaining locations had decreases of up to 7%.

Somewhat slower

The study showed that addition of retroreflective material to existing chevrons and use of on-pavement curve markings as supplementary treatments were moderately effective in most cases. The treatment had the greatest impact in decreasing the percent of vehicles traveling 5, 10, 15 or 20 mph or more over the advisory speed. **R&B**

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