EVALUATION OF THE EFFECTIVENESS OF VERTICAL DEVICES AS A SPEED TRANSITION ZONE COUNTERMEASURES IN SMALL, RURAL COMMUNITIES

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1. BACKGROUND
Speeding is a major contributing factor in around 30 percent of fatal crashes nationally in the United States (1). Speeding in rural communities located along major highways is especially problematic given that drivers must transition from a major high-speed, rural roadway to a low-speed community setting. The rural roadway provides high-speed mobility outside the community, yet the same road within town provides local access and accommodates pedestrians as well as on-street parking, bicycles, and other features unique to the character of a small rural community. Since many rural communities are small, no clear delineation between rural homes and an actual township may be evident. As a result, drivers who have been traveling for some distance on a high-speed road outside the community may not receive the appropriate clues that the character of the roadway is changing and may not adjust their speed appropriately. Consequently, drivers often enter at high speeds and maintain those speeds as they travel through the community.

Addressing speeding issues in rural communities is particularly challenging given that small rural communities often lack the engineering expertise and resources necessary to effectively address the persistent challenge of slowing high-speed through traffic. While traffic calming has been evaluated and used extensively on lower-speed urban roadways in the US, little information is available regarding the types of traffic-calming techniques that are appropriate and effective along major highways transitioning within rural communities. Typical traffic-calming techniques used on lower-speed roadways cannot be assumed to be portable to higher-speed roadways.

To address the challenges of speed management along major highways through rural communities, the research team conducted a study to assess the effectiveness of different traffic calming countermeasures which were appropriate to the rural setting. Eleven different countermeasures were selected and evaluated in ten different small rural Iowa communities (USA) (typically < 5,000 population) (2; 3). This paper summarizes results for two of those countermeasures which utilized traffic control devices to narrow lanes and create vertical deflection. The objective of the countermeasure was to reinforce the changing nature of the roadway as drivers entered the community and to provide a sense of vertical friction.

2. DESCRIPTION OF COUNTERMEASURES
Two different vertical deflection countermeasures were evaluated in two different small rural communities in Iowa (USA). The first was a center island widening and the second consisted of raised curbing.
2.1. Center Island Using Delineator Posts

The first countermeasure consisted of two rows of tubular channelizers placed parallel along the centerline to create a small vertical island. A speed limit sign was placed at the terminal points as shown in Figure 1. The countermeasure was placed at several locations along the major road in the community of Slater, Iowa (pop = 1,489). The countermeasure was placed just past the south community entrance extending within the community.

![Figure 1: Center Island Widening Using Tubular Channelizers](image)

2.2. Raised Curbing as a Center Island Treatment

The second vertical countermeasure consisted of commercially available temporary curbing (approximately 2 inches high by 40 inches long by 8 inches wide). The curbing has a rounded design which can be mounted by errant vehicles. The countermeasure was placed at the community entrance at the north, south, and west community entrances (county or state highways) in the town of St. Charles, Iowa (pop = 653) and extended several hundred feet past the entrance into the community.

Hazard markers were placed at the begin and end of the countermeasure so that drivers were aware that a vertical object was located within the traveled roadway. The installed countermeasure is shown in Figure 2. The countermeasure was placed at the west, north, and south community entrances. The east community entrance was characterized by a horizontal curve so the countermeasure was not appropriate for that location.

![Figure 2: Vertical Countermeasure using Temporary Curbing](image)
3. Analysis and Results

Pneumatic road tubes (JAMAR FLEX HS counters) were used to collect speed and volume data before and at several time periods after installation of the countermeasures. Road tubes were typically laid just downstream of the countermeasure and data were collected for 48 hours on a Monday through Friday under mostly dry weather conditions. In a few cases, due to issues with the traffic counters, data were available for only a 24 hour period. Use of full 24 hour periods avoids biasing the speed sample to speed based on time of day. The collection periods occurred Monday through Friday while avoiding holidays to avoid any unusual traffic patterns.

The most common statistics used in the speed analyses were mean and 85th percentile speeds. A number of studies have also reported change in the number of drivers traveling a certain threshold over the posted or advisory speed. For instance, the fraction of drivers in the sample traveling 10 or more mph over the posted speed limit before installation of the countermeasure is compared with the fraction traveling 10 or more mph over after the countermeasure is installed. This metric may be more meaningful than mean or 85th percentile speed because it reflects reduction in high-end speeding and not just average changes in speed.

The percent change between the fraction of vehicles exceeding the posted or advisory speed before and after installation of the signs was calculated using equation 1:

\[ \text{Cp} = \frac{\text{FR}(\text{after}, x) - \text{FR}(\text{before}, x, i)}{\text{FR}(\text{before}, x)} \]  

where:

- \( \text{FR}(\text{before}, x) \) = fraction of vehicles exceeding posted or advisory speed by \( x \) mph for before period
- \( \text{FR}(\text{after}, x, i) \) = fraction of vehicles exceeding posted or advisory speed by \( x \) mph for after period \( i \)
- \( \text{Cp} \) = percent change

3.1 Center Island Using Delineator Posts

Results for the center island countermeasure in Slater are shown in Figures 3 and 4. Data were collected just past the community entrance at the city limits (CL) and several blocks north at 8th Street. Results are shown for vehicles in the northbound direction for both locations. Northbound vehicles were those which were entering the community.

As noted in Figure 3, mean speeds decreased between 2.5 and 3.3 mph at 1-month and 0.5 to 2.4 mph at 12-months after installation of the countermeasure. Similar results were found for reductions in 85th percentile speed.
speeds which decreased by up to 3 mph at 1-month and 1 mph at 12-months.

Figure 4 provides a summary of the decrease in vehicles traveling 5 or 10 mph over the posted speed limit of 25 mph. As shown, the percentage of vehicles traveling 5 or more mph over the posted speed decreased by up to 48% for the 1-month after period and up to 33% for the 12-month period. The percentage of vehicles traveling 10 or more mph over the posted speed limit decreased by up to 53% for the 1-month and 32% for the 12-month after period. In most cases, decreases were greater within the community (8th St) than at the community entrance (CL).

3.2 Raised Curbing as Center Island Countermeasure

Figure 5 summarizes results for the center island countermeasure which utilized raised curbing in St. Charles. Mean speeds decreased by 2.2 and 1.9 mph at 1 month after installation of the countermeasure at the north and south entrances. Mean speeds increased slightly at the west entrance. Mean speeds were reduced by 2.6 and 2.2 mph also at the north and south community entrance 12-months while no little change was noted at the west entrance.

Reductions in 85th percentile speeds were similar with a reduction of 3 and 1 mph at 1-month at the north and south entrances respectively with no change at the west entrance. At 12-months, reductions up to 3 mph were found in 85th percentile speeds at all locations.

Figure 6 illustrates decrease in vehicles traveling 5 or 10 mph over the posted speed limit of 25 mph. As shown, the percentage of vehicles traveling 5 or more mph over the posted speed decreased by up to 29% for the 1-month after period for the north and south entrances which a small increase (6%) was noted for the west entrance. At 12-months after, decreases up to 37% were noted for all locations.
The percentage of vehicles traveling 10 or more mph over the posted speed limit decreased by up to 46% for the 1-month and 50% for the 12-month after period for the north and south entrances. The west entrance experienced a small increase at 1-month and no change at 12-months.

4. CONCLUSIONS

Speeding in rural communities located along major highways is especially problematic given that drivers must transition from a major high-speed, rural roadway to a low-speed community setting. Coupled with limited resources and lack of knowledge about countermeasures which are applicable to rural settings, many small rural communities struggle to adequately address speeding. This paper summarized results of two different speed management countermeasures which utilized traffic control devices to create lane reduction and vertical friction.

Both countermeasures were placed so drivers encountered the countermeasures as they entered the rural communities. Both countermeasures were reasonably effective in reducing vehicle speeds. Reductions of up to 3 mph in mean and 85th percentile countermeasure were noted. The change in drivers traveling a 5 or 10 mph over the posted or advisory speed also decreased significantly. This metric may be more meaningful than mean or 85th percentile speed because it reflects reduction in high-end speeding and not just average changes in speed.

Changes were statistically significant in most cases and were calculated using a t-test or test of proportions. In the interest of brevity, extended results are not provided here but are available in project reports (see references 2 and 3).

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REFERENCES