TEMPORARY LOW PROFILE BARRIER FOR ROADSIDE SAFETY: PHASE II

PROBLEM STATEMENT

Work zones represent a type of roadside environment in which special attention must be given to barrier height if adequate line of sight is to be provided to both the traveling public and work zone personnel. Longitudinal concrete barriers possessing a high profile (tall cross-section) provide excellent separation of roadway traffic from roadside work zone activities. Errant vehicles coming into contact with such barriers are safely redirected back onto the roadway, thus protecting both the driver and individuals present in the work zone. However, while high profile barriers provide excellent redirection and separation capabilities, they can also obscure a driver's field of view and lead to accidents.

Historically, the process used to design temporary longitudinal barrier systems focused primarily on issues such as redirection capability, minimization of vehicle intrusion into the area being protected, and portability. Barrier systems must be capable of redirecting a variety of different vehicle types in a smooth and stable manner without causing rollover. Simultaneously, they must limit vehicle intrusion into the work area to an acceptably small extent. High-profile barriers with substantial mass most easily achieve these design criteria. However, the temporary nature of most work zones also requires that barrier segments be lightweight and portable enough that they can be installed, repositioned, and removed with reasonably little effort. In order to simultaneously meet both the redirection and portability criteria, designers have most often turned to concrete barriers with high profiles but short segment lengths, thus producing relatively lightweight and portable segments.

Unfortunately, such design choices do not lead to optimal barriers. High profile barriers can obscure a driver's view of traffic. As a result, portable concrete barrier designs have emerged over the past decade that place additional emphasis on maintaining a *low profile*—thus avoiding the problems associated with limiting a driver's field of view—while still providing adequate protection and redirection performance. Low-profile barriers permit drivers to see traffic, encroaching vehicles, pedestrians, and construction traffic that might normally be obscured from view by tall barriers. Maintaining adequate line of sight through the use of low-profile barriers is particularly important in urban areas where vehicles pass numerous side streets and driveways at relatively low speed (e.g. less than 45 mph).

OBJECTIVES

During the first phase of research, a design concept for a low profile barrier wall was presented to the Florida Department of Transportation (FDOT). During and following this presentation, modifications to the design were suggested that would have the potential to improve the design. They included the following:

- Replace the square ends with beveled or radial ends to improve the degree of curvature in a multi-segment installation.

- Replace the connection rod between segments with cable (wire rope) for ease and flexibility of installation. Allow shear transfer between segments (lost by replacing the rod with the wire rope) through the use of a swaged shear sleeve.

The changes likely will alter the performance of the curb system in ways that are not easily predictable. The objective of this research is to test the efficacy of the proposed modified system.

FINDINGS AND CONCLUSIONS

The primary innovative feature of the new barrier is its ability to accommodate both horizontal and vertical roadway curvatures while maintaining both a low profile and the ability to successfully redirect errant vehicles. Other desired features include its low profile, lack of required roadway-anchorage, and geometric flexibility. Nonlinear dynamic finite-element simulation is used for conceptual design refinement, and full-scale crash testing is used to validate the final design. The barrier installation is able to successfully redirect errant vehicles without causing rollover or snagging of the vehicle, and lateral deflection of the barrier was minimal during the most severe conditions of the NCHRP 350 level 2 tests.

This barrier uses an entirely original segment-to-segment connection scheme in which shear forces and axial forces are carried by separate structural elements. Such a connection system provides reliable load transfer, uncomplicated field installation, and simple replacement of damaged segments. A unique method has been developed that permits the use of straight-line tensile bolts even in tightly curved alignments where the longitudinal axes of individual barrier segments may be rotated by as much as ten degrees from one segment to the next.

Phase I Barrier Design

Phase II Barrier Design

BENEFITS

The low profile barrier will provide a safer construction site by redirecting errant vehicles and, at the same time, by allowing improved visibility for vehicles entering or leaving the highway. The low profile barrier meets all of the requirements NCHRP 350 level 2 and will replace temporary curbs, which cannot meet that criteria.

This project was conducted by Gary Consolazio, Ph.D., P.E., Ralph Ellis, Ph.D., P.E., and Kurt Gurley, Ph.D., P.E., at the University of Florida. For more information, contact John Shriner, Project Manager, at (850) 414-4149, john.shriner@dot.state.fl.us.