Ohio Department of Transportation
Central Office, P.O. Box 899, Columbus, Ohio 43216-0899

January 31, 2005

Mr. Dennis Decker
Division Administrator
Federal Highway Administration
200 N. High Street.
Columbus, Ohio 43215

Re: Brifen Cable ISPE, Year 1 Report

Dear Mr. Decker:

On August 1, 2002, ODOT asked FHWA's Ohio Division Administrator to approve the installation of a proprietary cable system as an experimental project, As part of the subsequent agreement ODOT was tasked with providing a three year In-Service Performance Evaluation (ISPE) on performance of the products.

The aforementioned letter to Mr. Leonard Brown provided details of how the performance would be measured. Three reports will be provided to the FHWA Division. These reports were to be prepared one, two and three years after installation is complete and will include data on:

1) crash performance as well as repair problems & costs,
2) ongoing maintenance considerations & costs, and
3) conclusions (views from s afety and maintenance personnel regarding maintenance/repair and recommendations).

ODOT's Office of Roadway Engineering monitored the installation and maintenance on the completed barrier system in an effort to evaluate its performance in preventing cross-median crashes. The ISPE shows the system to be performing as well as was expected. The first year report is attached.

Respectfully,

Dirk B. Gross, P.E.

Dirk Gross, P.E.
Office Administrator
Office of Roadway Engineering Services

Attachment

Brifen WRSF In-Service Performance Evaluation
Year 1 Report - For the period from July 2003 to June 004
Prepared by Dean Focke, Standards Engineer, ODOT
January 31, 2005 (Revised 2/11/05)

INTRODUCTION

Cross medians accidents are a growing concern in the United States. In an effort to address the issue, the Ohio Department of Transportation (ODOT) received approval from the Federal Highway Administration (FHWA) to install a product that was new to the United States, but which has been effective in preventing such accidents overseas. This system is the Brifen WRSF, and it is a four-strand tensioned cable system of highly stressed cables that is reported to perform well (where sufficient deflection distance is available); and is easy to maintain. It also does not cause snow to drift, which is of interest to a northern state such as Ohio.

ODOT believed the advantages of this system over installing standard guardrail systems are:

1) A tensioned cable system should maintain its redirective function after being struck, unlike the generic cable that is inoperable after even a minor accident;
2) Reduce the frequency and severity of nuisance accidents by maintaining a large lateral offset in the median instead of having miles of Type 5 guardrail at the standard offset at both edges of shoulder;
3) Prevent costly grading required to move guardrail further off the shoulder in an attempt to reduce accidental impacts; and
4) Utilizing the cable to capture large vehicles which could tear through the w-beam system.

As part of the FHWA's agreement to allow ODOT to install the Brifen WRSF as an experimental project ODOT was tasked with providing a three year In-service Performance Evaluation (ISPE) on its performance.

These reports were to be prepared one, two and three years after installation is complete and will include data on:

1) Crash performance as well as repair problems & costs,
2) Ongoing maintenance considerations & costs, and
3) Conclusions (views from safety and maintenance personnel regarding maintenance, repair and recommendations).

ODOT's Office of Roadway Engineering monitored the installation and maintenance on the completed barrier system in an effort to evaluate its performance. This is the first year report.

Accidents on the system are investigated by District 8 personnel and are logged on a standardized "Tensioned Cable Guardrail Accident Report and Evaluation" form (Figure 1). Supporting data such as photos and accident reports are be obtained to compliment the forms. Each completed form includes data on vehicle damage, injury severity, damage to article as well as repair time and costs, parts availability, and out-of-service duration. This form was developed to meet the recommendations contained in NCHRP

Project 22-13 "In-Service Performance Evaluation of Traffic Barriers" (http://www.wpi.edu/Academies/Depts/CEE/ImpactlISPE/).

PROJECT LOCATION AND HISTORY

The location chosen for ODOT's first installation of a proprietary cable barrier was on Interstate 75 just north of Cincinnati, between State Routes 129 and 73 in Butler and Warren counties. The freeway at that location is a north-south 6-lane rural interstate, built during the 1960s, with good geometries. This section is a 14.5 mile section, mostly level and mostly tangential, that narrows to a 60 foot depressed median with 6:1 slopes and a 4-foot paved inside shoulder. (The highway on either end has a very wide median, as it was planned for future dual-dual lanes in the center median.) For a rural interstate it does have a high volume of traffic. In 2003 that section recorded an ADT of 92,000 with 22 percent trucks.

The section remained unremarkable until a rash of cross median fatal accidents over a short period of time. Within a 14 month period starting in the October 2000 there were 11 fatal accidents from cross median accidents. Investigation of each accident report showed no single reason for the accidents; all of them seemed to be unique.

The District responded by increasing police enforcement of the speed limit. Shoulder Rumble Strips were installed, with one fatal occurring afterwards. Obvious police presence returned until the installation of the barrier.

By autumn of 2002 the design of a tensioned cable system was complete, and by January 2003 construction of this emergency contract was underway. Due to harsh conditions that winter, construction was not complete until July 2003.

DATA COLLECTION (by Tom Arnold)

In 2003, the District began inspecting the newly installed cable rail system on IR-75 in Butler and Warren Counties. The main product of these inspections is the Accident Report and Evaluation form (Figure 1). In order to complete this form, three components of data must be gathered.

The first component of data is derived from the inspection process. Every week, District personnel perform field reviews of the wire rope. Basically, a vehicle equipped with a data collector is calibrated to match with the mile marker posts existing in the field. Then, the inspectors drive along the highway until a damaged section is observed. At that time, if it is the first observation of that specific damaged section, a picture is taken. If the damage section had occurred in a previous week, the damage is noted as still existing. This data allows for the evaluation of the second component of data collection, maintenance record investigation.

Using Graphic Query language (GQl), a query that summarizes the cost of labor, equipment, and material used in fixing the wire rope is produced. Based on the date and log, the inspection data is matched with the query data. This information is also checked with the third component of data collection, OH-1 (State Highway Patrol) accident report. Based on the locations were the number of posts replaced is known from inspection and GQL data, the average cost to fix a crash is about $109.93 per post. In other words, when a crash occurs, one can estimate the total cost of material, labor, and equipment based on how many posts have been damaged. This cost may be slightly high because as damaged sections have been repaired, the maintenance crews have been replacing driven posts with socketed posts in concrete foundations.

State Highway Patrol sends in accident reports involving the wire rope as they identify them. Again, based on the date of the accident and the log point, this data is linked with the inspection and maintenance data to fill out the evaluation form. Periodically, a query is run on the ODOT accident data. This data is compared to the data received from the State Highway Patrol in order to fill in any holes in the data. All of the crash data is summarized in a spreadsheet which also determines if a vehicle crossed the ditch during the accident or if the crash occurred within 2000 feet of an interchange. Because construction of the cable rail was completed in July of 2003, crash data is also divided into 3 years, each year running from July to June.

In some cases, accident reports are received that do not have corresponding maintenance data and vise versa. Though incomplete, this data is still entered in an evaluation form. The most likely explanation of this occurrence is that the damage was the result of a hit-and-run collision. Based on the crash data gathered during Year 1, approximately 28% (33 out of 87) of the crashes involving the cable rail have been hit and-run crashes.

There are some other obstacles to creating reliable data in this manner. The most difficult of these obstacles is the logging of these crashes. Unfortunately, log points from inspection, maintenance records, and crash reports do not always match. As a result, comparing the date of the crash, the date of the inspection, and the date of the maintenance must be the deciding factors when linking data, as long as the log points are not too far off. From the District's perspective, this process has been successful at linking the crash and maintenance data to damage to the wire rope.

For access to the completed Accident and Report forms and other information online, contact Dean Focke, Standards Engineer, dean.focke@dot.state.oh.us).

CRASH PERFORMANCE (by Tom Arnold)

When evaluating the performance of the cable rail, three criteria may be used: the number of injuries that have occurred as the result of crashes, the number of crashes resulting in penetration of the cable barrier, and the number of vehicles that have crossed the ditch and struck the barrier.

According to the data collected in Year 1, about 10.3% (9 out of 87) of the crashes that have occurred resulted in injuries. (Crashes that are designated as hit-and-run do not have injury data and were not included in the calculation). The severity of the injuries sustained is summarized in Table 1.

Table 1: Summary of Injury Severity

OH-1 CODE	INJURY TYPE	FREQUENCY
1	None	5
2	Possible	4
3	Non-Incapacitating	8
4	Incapacitating	-
5	Fatal	-
6	Unknown	1

Of the 18 passengers that were traveling in vehicles that were involved in the 9 injury crashes, 13 sustained injury and 5 were uninjured. No cross median fatalities have occurred in this section of IR-75 since the cable rail was installed.

Based on the data gathered in Year 1, only 4 crashes have involved possible penetration of the cable rail. Penetration of the rail is defined as a vehicle under-running, overrunning, piercing, or overturning over the cable rail. None of the vehicles in these cases entered the opposing lanes of traffic.

One key crash that surprisingly did not result in penetration of the cable involved a Mack truck. In this instance a Mack truck penetrated two lines of guardrail but was stopped by the cable rail. Please refer to Figure 2 for a picture of the resulting damage.

Figure 2: Mack Truck Collision

According to the OH-1 report, the truck that struck the cable rail in this instance was the Econodyne model produced by Mack in 1998.

Finally, a high number of crashes have occurred after a vehicle crossed the ditch. The cable rail is not situated in the middle of the median on IR-75; it alternates sides of the median throughout its length. 29% (25 out of 87) of the crashes have involved a vehicle crossing the ditch to strike the cable barrier. If it is assumed that even a portion of those crashes in which a vehicle crossed the ditch would have also resulted in the vehicle entering the opposing lanes of travel, then a number of severe injury and even fatal crashes have been avoided by the installation of the cable rail.

In summation, based on the low number of injury crashes, the low number of instances of penetration of the rail, and the number of vehicles stopped after crossing the ditch, the cable rail appears to be performing very well.

OFFICE OF SAFETY AND MOBILITY VIEWS (By Don Fisher)

As the concern for median safety has risen, the need for a low cost, easy to maintain, and reliable median barrier system has grown. The Brifen system offers a low cost median barrier alternative which promises to eliminate the severe injuries caused by a cross-median crash event. The data collected by District 8 will be used to monitor: the severity of impacts with the barrier, cost to maintain the system, timeliness of repairs, any increase in the number of crashes and determine best practices for maintenance and installation. The lessons learned from the District 8 installation will then be incorporated into any future installations throughout the state.

We have not conducted an in depth analysis to date, however, we expect that the total number of crashes occurring in the area have increased due to the presence of a median barrier in the clear zone. While the number of crashes occurring has probably increased, the severity should decrease dramatically since the barrier has prevented any cross median crashes. District 8 personnel have stated that in most cases a vehicle striking the barrier is able to drive away with minimal damage. In reviewing the known crash reports of the crash events, the number of injuries has been very low. As part of the District repairs to the system, a socket post system is being installed to ease future maintenance. In summary, the system has performed as expected and prevented any cross median crashes in an area with a history of severe crash events.

FIRST YEAR CONCLUSIONS

The crash performance of the barrier is, after the first year, within expectations for the product. It appears to function appropriately although it will be prudent to continue to gather data for another two years. So far, no serious injuries or fatalities have occurred, which is what this Department was anticipating. It is also important to note that most of the 87 accidents occurring the first year would not have happened if the system was not installed. In other words, the installation of the system increased the number of accidents tremendously, albeit the severities of the accidents most likely were significantly reduced.

The District staff has learned the system and is now comfortable with the maintenance considerations. One lessoned learned is the use of socketed posts in concrete foundations. Most of the original posts were driven into the median slopes during installation, but after only a few hits, it was decided to replace all damaged post with concrete foundations so that socketed posts could be used. The District believes the simplicity of repairs outweighed the cost of installing individual foundations. The $109 per post cost ($10.40 per foot) in a previous section includes the costs of this foundation improvement.

No cross median fatalities have occurred in this section of IR-75 since the cable rail was installed.