SAFENCE WIRE ROPE MEDIAN BARRIER

Construction Report
September 2005

Steven D. Roper, P.E.
Project Manager
Wilson B. Brewer, Jr.
Project Manager

Planning & Research Division
Oklahoma Department of Transportation
200 N.E. 21st Street, Room 3A7
(405)521-2672
FAX (405)521-6917

The contents of this report reflect the views of the authors who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the views of the Oklahoma Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation. While trade names may be used in this report, it in not intended as an endorsement of any machine, contractor, process, or products.

TECHNICAL REPORT DOCUMENTATION PAGE

1. REPORT NO.	2. GOVERNMENT ACCESSION NO.	3. RECIPIENT'S CATALOG NO.
FHWA/OK	FHWA/OK	TE228 .R67 2005
4. TITLE AND SUBTITLE		5. REPORT DATE
SAFENCE WIRE ROPER MEDIAN BARRIER		
		6. PERFORMING ORGANIZATION CODE
		Item No. 2130
7. AUTHOR(S)		8. PERFORMING ORGANIZATION REPORT
Steven D. Roper and Wilson Brewer		
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. WORK UNIT NO.
		11. CONTRACT OR GRANT NO.
		Item 2130
12. SPONSORING AGENCY NAME AND ADDRESS		13. TYPE OF REPORT AND PERIOD COVERED
Planning & Research Division 200 N.E. 21st Street, Room 3A7 Oklahoma City, OK 73105		
		14. SPONSORING AGENCY CODE
		Oklahoma Department of Transportation

15. SUPPLEMENTARY NOTES

16. ABSTRACT

The Safence Cable Barrier System is designed to minimize or eliminate crossover accidents on divided roadways. This system uses four tensioned cables stacked vertically to prevent errant vehicles from crossing the median into oncoming traffic. This report documents the Oklahoma Department of Transportation's field test of this product.

The barrier was easily installed and maintenance repairs require minimal time or equipment. The test section has been hit several times and has performed as designed every time.

17. KEY WORDS	18. DISTRIBUTION STATEMENT		
Safence Cable Median Barrier Wire Rope Crossover	No restrictions. This publication is available from the office of Planning and Research Division, Oklahoma DOT.		
19. SECURITY CLASSIF. (OF THIS REPORT)	**20. SECURITY CLASSIF. (OF THIS PAGE)**	**21. NO. OF PAGES**	**22. PRICE**
Unclassified	Unclassified		

SAFENCE WIRE ROPE MEDIAN BARRIER

CONSTRUCTION REPORT

Steven D. Roper, P.E.

Project Manager

Wilson B. Brewer, Jr.

Project Manager

Under the Supervision

of

Dawn R. Sullivan, P.E.

Division Engineer

Planning & Research Division

Oklahoma Department of Transportation

200 Northeast 21st Street Room 3A7

Oklahoma City, Oklahoma 73105

September 2005

TABLE OF CONTENTS

LIST OF FIGURES

INTRODUCTION

Safence, a steel cable highway barrier system, is being tested on a section of I-35 from the SH 74 junction at Goldsby (Exit #104) extending north one mile in Mc Clain County. The Federal Highway Administration (FHWA) requires that experimental products be evaluated prior to being used on Federally funded projects. Because Safence is currently an experimental product to the State of Oklahoma, the Planning & Research Division was asked to conduct an evaluation of Safence's installation methods and performance.

Blue Systems commenced operations in 1992 and began producing wire rope barriers in 1993 called "Safence". According to the manufacture, safence barrier has a unique property: "The barrier catches the car and allows it to 'hang' in the wire ropes as if in a hammock, while the posts are bent when the car collides with them and are released from the wires" (1).

At present, the majority of center median barrier systems used in Oklahoma are reinforced concrete walls. Another median barrier system used in Oklahoma is the "Brifen Wire Rope Safety Fence." These systems have met the safety requirements of NCHRP- 350 Test Level Three vehicles, a small 4500 lb pick-up truck. The test requirements are:

1) Structural adequacy
2) Occupant risk
3) Vehicle trajectory.

OBJECTIVES

The objectives of this project are as follow:

- Monitor construction and document procedures.
- Document procedures for specification changes.
- Compare construction procedures to a proven product.
- Record crash and safety results.
- Do a final report on construction and investigation results.

CONSTRUCTION OPERATION

Installation of the Safence cable barrier was completed on September 24, 2004 by MidState Traffic Control construction company. The cable anchors are concrete foundations measuring 5'-6" x 3' x 6'. The top of the foundation is placed at ground level. All cables are anchored by the single foundations at each end of the test section. See Figure 1(a-d) for anchor placement. An additional slab (41'-0" x 8' x 6") was formed and placed around the foundation hole for sand impact attenuator barrels. See Figure 2(a-b).

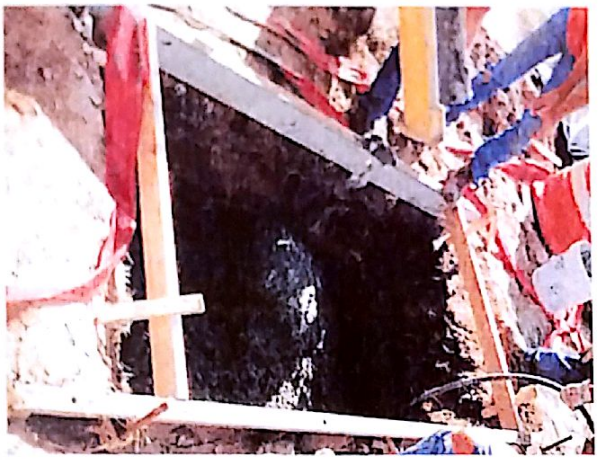

Fig. 1a: Concrete is poured into the cable anchor.

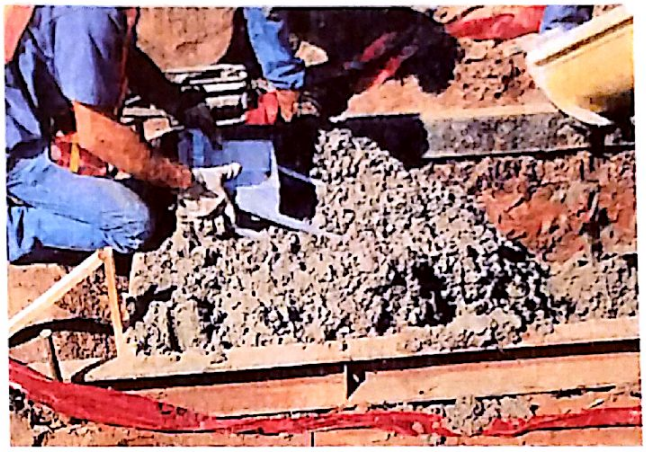

Fig 1b: Placement of anchor plate in fresh concrete.

Fig. 1c: Anchor plate is set in place.

Fig. 1d: Cable anchor concrete is finished.

Fig. 2a: Placing concrete for attenuator slab.

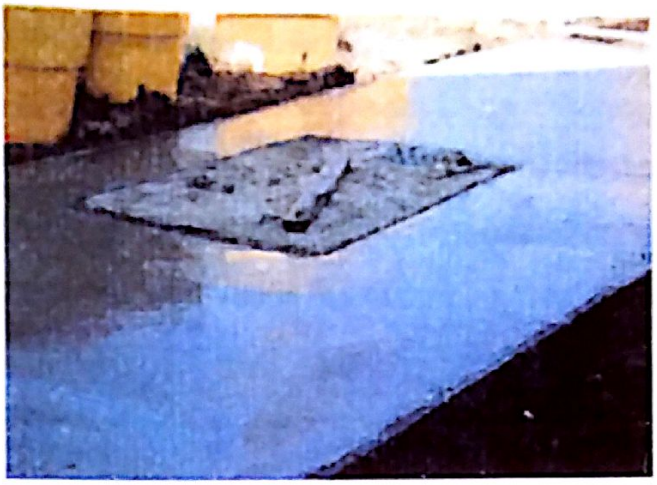

Fig. 2b: Finished attenuator slab.

The location of the support posts were hand surveyed with a tape measurer and string line. The post spacing was set at 10 feet. The foundation hole for the post hole was pile driven in by a GRT, Utilicorp truck. See figure 3(a-d). The driver was a solid steel shaft that measured 12 inches in diameter. The holes were each driven to two feet in depth.

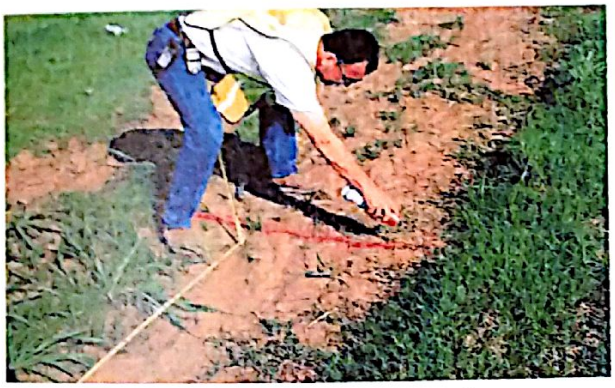

Fig. 3a: Marking linear position of post base.

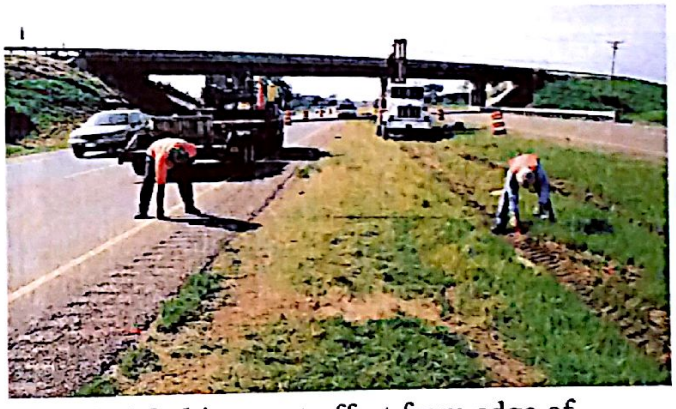

Fig. 3b: Marking post offset from edge of pavement.

Fig. 3c: Compacting soil to form post base holes.

Fig. 3d: Completed post base hole.

A string line was used for setting the alignment of the post sleeves while the concrete was placed. Concrete was poured into the hole and square reinforcement ring was placed in the concrete, approximately half way down. A "2 X 4" piece of wood was used to "force the post sleeve into the fresh concrete so that the top of the sleeve was the same as the surrounding soil. The concrete was then hand finished and the concrete was cured for two days. See figure 4(a-e)

Fig. 4a: Placing concrete for post bases.

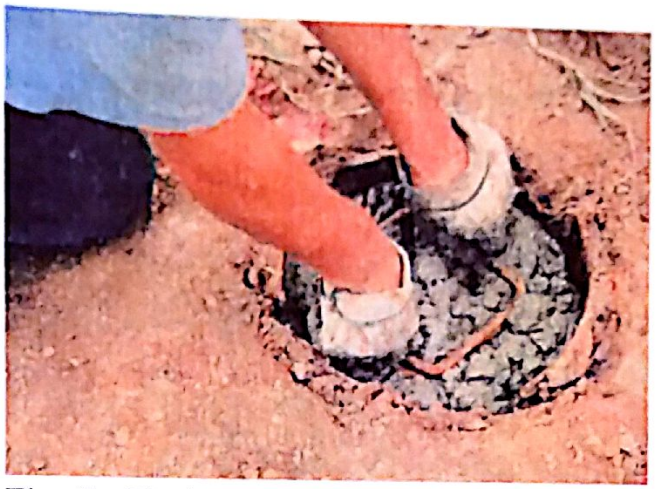

Fig. 4b: Placing reinforcing steel into base.

Fig. 4c: Placing post sleeve into concrete base.

Fig. 4d: Using bubble level and string line to set post position and alignment.

Fig. 4e: Finishing the post base.

After the two day set, the bottom caps were placed on the posts, and the posts were set in the metal sleeves. The first, or bottom, cable was then screwed to the anchor and strung through the posts. The Cable was pre-cut in 1000 feet lengths which were joined by rigging screws. After the first cable was placed, a metal spacer was placed into every post. This procedure was repeated, until all four strands of cable were placed. Then a blue cap was placed on the post. The cables were tensioned at the rigging screws by a hand powered apparatus. Then the rigging screw would be adjusted and the apparatus was removed. This adjustment was made at each rigging screw on every strand of cable. See figure 5 (a-o).

Fig. 5a: Posts and base caps in position ready for cable placement.

Fig. 5b: Cutting cable for end fitting.

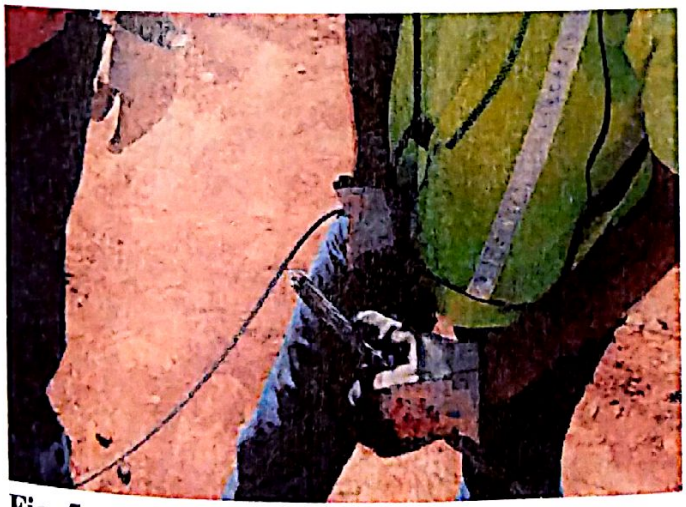

Fig. 5c: Attaching check rope.

Fig. 5d: Placing end fitting on cable.

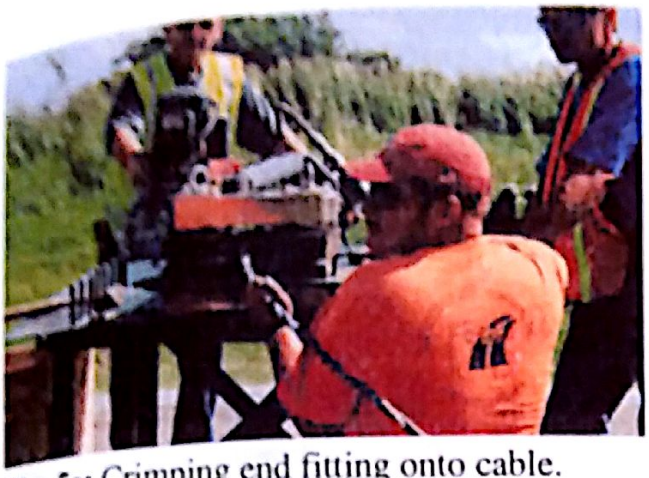

Fig. 5e: Crimping end fitting onto cable.

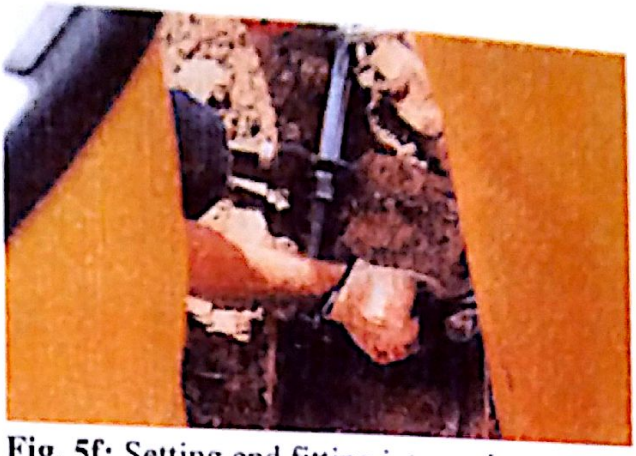

Fig. 5f: Setting end fitting into anchor.

Fig. 5g: Placing bottom cable into posts.

Fig. 5h: Placing second cable and inserting spacers for third cable.

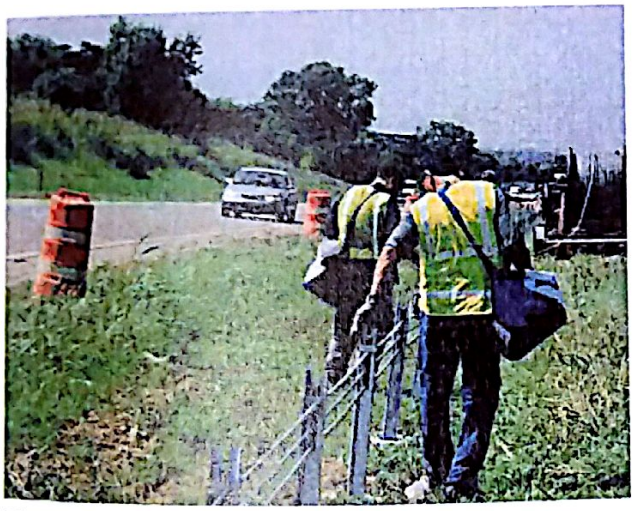

Fig. 5i: Placing stiffening frame between the third and top cables.

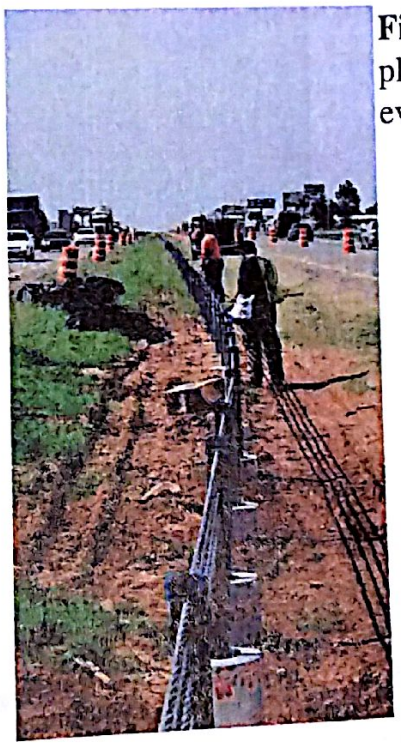

Fig. 5j: Placing plastic caps on every post.

Fig. 5k: Tensioning cable three.

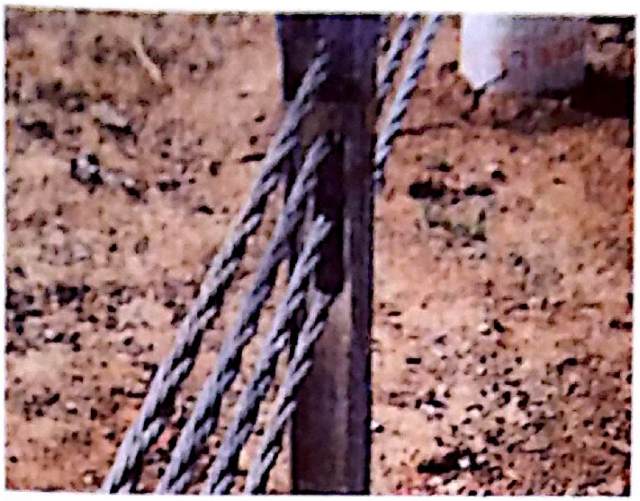

Fig. 5l: Close-up of finished post assembly.

Fig. 5m: Fully assembled and tensioned Safence Cable Barrier System in place on I-35 in Mc Clain County.

INVESTIGATION

In the three years prior to the installation of the Safence Cable Barrier System, three "crossover" collisions were reported. After 6 months of service, the mile of cable has received at least 6 hits. Accord to the Division 3 Risk Manager, none of the accidents have been life threatening. Of the 6 accidents, only three reports were filed by the Oklahoma Highway Patrol. As of the completion of this report, the Safence Cable Barrier System had successfully prevented median crossovers every time the system was hit.

CONCLUSION

This report evaluated the Safence Cable Barrier System based on structural adequacy, occupant risk, and vehicle trajectory.

The Safence Cable Barrier System was hit on several occasions and the structure of the system proved adequate each time. Each time the barrier was hit, the posts folded over as intended and the cables stretched slightly upon impact but did not break under tension. See figure 6 (a-f).

Fig. 6a: Posts have broken away after vehicle collision with fence, but the cable remains intact.

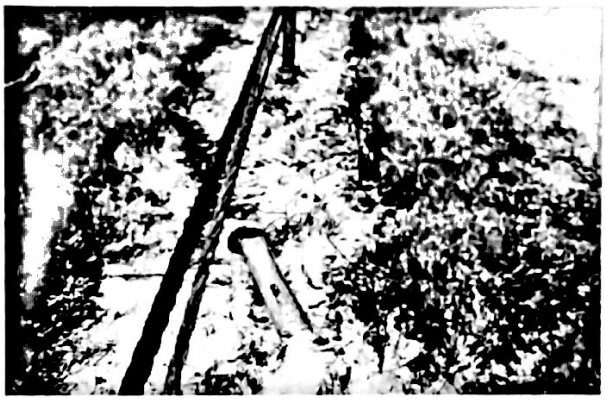

Fig. 6b: Close-up of post folded down while cable remains intact.

Because the cables stretched slightly upon impact, the negative acceleration experienced by the vehicle occupants was lessened, helping to reduce occupant risk. Since installation, no injuries have been reported as a result of collisions with the Safence Cable Barrier System.

Collision reports were available and reviewed for two of the reported collisions. In both collisions, the vehicles' trajectory was such that the vehicles remained in the median and did not return to the driving lanes of either direction.

Although there have been only six collisions involving the Safence Cable Barrier System, the system has shown success each time. The Safence Cable Barrier System has met all requirements of this test, and should be used further on ODOT projects where median crossovers are an issue.

REFERENCES

1. "Wire Rope Safety Fence", *Safence*, Blue Systems AB, Vastra Frolunda, Sweden.

2. Kircher, James R., "New Barrier System Prevents Vehicle Crossovers," Public Work Engineering, Construction & Maintenance, Vol. 132, No. 12, p. 52. November 2001.

3. Ross, H. E., Sickling, D. L., Zimmer, R. A., Michie, J. D., "Recommended Procedures for Safety Performance Evaluation of Highway Features," National Cooperative Highway Research Program, Washington, D.C., 1993.

4. Emamian, Faria, "Brifen Wire Rope Safety Fence" Final Report, Oklahoma Department of Transportation, Traffic Engineering Division, Oklahoma City, Ok., March 2003.