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Keeping Traffic on the Right Side of the Road

by Gary Stasburg and Lisa Crist Crawley

North Carolina saved lives by installing cable barriers on freeways where the median width is less than 21 meters (70 feet).

The cable median barrier stopped this semitrailer truck, preventing a potentially deadly cross-median crash. Photo: NCDOT.

Cross-median crashes pose a significant hazard for motorists across the country, claiming numerous lives and causing millions of dollars of damage each year. To help combat this risk, the North Carolina Department of Transportation (NCDOT) implemented an aggressive and successful strategy to prevent vehicles from crossing medians, establishing the State as a national leader in the ongoing challenge to keep traffic on the right side of the road.

According to *Saving Lives by Preventing Across Median Crashes in North Carolina*, a document outlining a 1998 study conducted by NCDOT, more than 38 people lose their lives and nearly 300 others are injured in cross-median crashes on North Carolina freeways each year. Furthermore, those crashes are found to be three times more severe than other crashes, making their prevention a high priority for officials throughout the State.

However, through research studies by NCDOT and the subsequent installation of protective median barriers, the State has reduced its cross-median crashes dramatically, cutting the number of fatalities from these crashes nearly in half during installation of the median barriers from January 1999 through December 2003, and saving hundreds of millions of dollars in fatal crash costs alone. Many of the cross-median crashes that were still occurring during this time were on stretches of highway that were slated to receive median barriers but had not yet had them installed.

The Unique Challenge of Cross-Median Crashes

A number of factors make the problem of cross-median crashes difficult to solve.

First, there is no identified pattern for when and where the crashes occur. NCDOT research has demonstrated that they do not occur during a specific time of the day or day of the week, and there does not appear to be a well-defined season of the year for these crashes. Cross-median crashes take place on both horizontally and vertically curved sections of highways, as well as along straight and flat sections. In addition, there is no single cause of these crashes; the events that lead to a cross-median crash include everything from fatigue and improper lane changes to inattention and medical emergencies.

Compounding the problem, hundreds of miles of North Carolina freeways were constructed with medians between 11 and 15 meters (36 and 50 feet) due to right-of-way costs and environmental constraints. With such a short distance between the opposing lanes of these highways, in about the time it takes to yawn, change a radio station, or answer a cellular phone call, a vehicle traveling at posted freeway speeds can cross a median and strike opposing traffic head-on. Traffic volumes on the State's highways also are increasing at a rapid rate, making the risk of devastating cross-median crashes even greater.

The good news is, regardless of the circumstances of cross-median crashes, research has shown that most of them can be prevented through the installation of a protective median barrier. This reduction in crashes was evident from the outset of North Carolina's median barrier program, when in 1997 NCDOT tested an initial section of cable barrier in the Raleigh-Durham area and found that it significantly lessened the severity of cross-median crashes. "Prior to installation of a median barrier in the Raleigh-Durham area, there had been an average of one fatal crash every year," says Shawn Troy, NCDOT traffic engineer. "Afterwards there were none, and the seriousness of the injuries from crashes in the area also had decreased significantly."

The Median Barrier Story Begins

This success story actually begins 4 years prior to the first installation, with a 1993 cross-median research study by NCDOT.

"The department was concerned about the unusually high severity of cross-median crashes," says Kevin Lacy, State traffic engineer for NCDOT. "We decided it was time to look for ways to minimize this safety hazard."

The 1993 study used available crash history to identify 24 interstate locations totaling 148 kilometers (92 miles) that had an unusually high number of cross-median incidents. The researchers recommended prioritized safety improvements, primarily placement of median barriers, at these locations. These safety improvements were either constructed at the time or programmed into the NCDOT Transportation Improvement Program (TIP).

The North Carolina Department of Transportation installed this cable guardrail along Interstate 540 in Wake County, NC.

NCDOT also planned to use the study data to develop a model that would aid in identification of potentially dangerous locations on North Carolina interstates based on relevant variables such as median width, traffic volume, and other

geometric and operational characteristics. This final objective of the research proved to be difficult to attain, however, leading to additional examination of cross-median crashes in the State.

In 1997, NCDOT revised the 1993 cross-median study to include 48 kilometers (30 miles) of additional interstate locations prioritized for placement of median barriers. Despite these additional data, NCDOT researchers still needed a more comprehensive study to help identify where cross-median crashes were likely to occur.

Sample Installations of Median Guardrails in North Carolina
Source: NCDOT

Location	Miles (Length)	Cross-median Crashes Per Year Before Installation	Cross-median Crashes Per Year After Installation	Fatal Cross-median Crashes Per Year Before Installation	Fatal Cross-median Crashes Per Year After Installation
I-26 from Buncombe County Line To MM 23.8 and Green River to Polk County Line	16.48	7.54	0.32	0.56	0.00
I-40 from SR 1138 to 0.201 miles West of US 64	6.809	3.96	0.00	0.55	0.00
I-40 from US 70 to 1.0 mile east of US 221	13.94	5.58	0.00	0.56	0.00
I-95 Bus from 250' South of Cross Creek Bridge to 1060' north of US 301	5.00	3.15	0.00	0.30	0.00
I-40 from Johnston County Line to Pender County Line	20.19	5.18	0.67	0.14	0.00

A Closer Look

In 1998, NCDOT conducted a second cross-median study that examined all such crashes on North Carolina freeways from 1994 through 1997. The primary objective was to reduce the number and severity of cross-median crashes on the State's high-speed highways by establishing a warrant for median barrier placement and by identifying divided freeways (both interstate and noninterstate) that have cross-median crash histories.

The study investigated more than 800 cross-median crashes along approximately 2,214 kilometers (1,375 miles) over a 3.5-year study period. Area staff investigated each identified section of divided freeway and also identified additional candidate locations. The study concluded that there were more than 1,932 kilometers (1,200 miles) of candidate freeway in North Carolina, the majority of which had median widths of less than 21 meters (70 feet).

"The study was finished in 1998," says Lacy. "Its findings provided a great deal of momentum to convince upper management of the need for more barriers, and the Board of Transportation subsequently approved $120 million for barrier installation. As a result, nearly 1,610 kilometers (1,000 miles) of barrier were placed across the State." This series of 62 projects to place median barriers on

North Carolina freeways began in 1999 and was completed in 2004.

Another cable guardrail installation on Interstate 540 in Wake County, NC, showing an extremely narrow median.

The Federal Highway Administration (FHWA) also played a significant role in ensuring that median barriers would become a reality across the State. Nicholas Graf, the FHWA division administrator in North Carolina at the time, sent correspondence to the NCDOT leadership and appeared before the Board of Transportation to identify reduced highway fatalities from cross-median crashes as a FHWA focus area.

"The division office has been very supportive of NCDOT's efforts to reduce highway fatalities," says Division Administrator John F. Sullivan III. "NCDOT's median barrier program has truly brought a new level of safety to the State's highways and has proved to be a valuable model for other States." FHWA also provided needed data concerning median barriers, including examples of cross-median crash studies and the median policy from California, as well as other information necessary for NCDOT to complete its 1998 report.

Implementation of the Study Results

The results of the two studies became a three-pronged proactive strategy to save lives by preventing cross-median crashes. The first phase was to install protective median barriers on freeways with cross-median crash histories. The second phase was to systematically protect all freeway sections with median widths of 21 meters (70 feet) or less. The third phase consisted of revising policies to prevent the construction of additional freeway sections with unprotected narrow medians.

Phase 1—Installing Median Barriers. When the process of installing barriers began, NCDOT used a number of different types. For a 14.5-kilometer (9-mile) stretch of interstate in the Raleigh-Durham area that carries some 90,000 vehicles per day and has the worst crash rate in the State, the agency decided to use cable guardrail. In other cases, NCDOT left it up to the construction teams as to the type of barrier to use. The type installed depended on a number of site conditions, namely median width and slope. However, the agency typically recommended installing cable barrier where design constraints were met because it is less expensive, causes less damage to vehicles, and is easiest to replace.

Phase 2—Protecting Freeways with Narrow Medians. To ensure that freeway sections with median widths of 21 meters (70 feet) or less would be protected by median barriers, it was suggested that the American Association of State Highway and Transportation Officials' (AASHTO) *Roadside Design Guide* be changed to present a stricter standard for the installation of median barriers. "NCDOT's research and the results that the agency has achieved in terms of saving lives indicate the need to revisit the AASHTO design guide," says Lacy.

Cable Barrier Systems at a Glance

Cable barriers have been used on the Nation's highways since at least the 1930s. The modern system, which uses three cables supported by weak steel posts, was developed in the 1960s and has been used successfully by several States. Since 1989, AASHTO's Roadside Design Guide has contained information on a cable median barrier design that mounts the middle cable on the opposite side of the posts from the other two cables, allowing the barrier to contain and redirect vehicles that strike the system from either side.

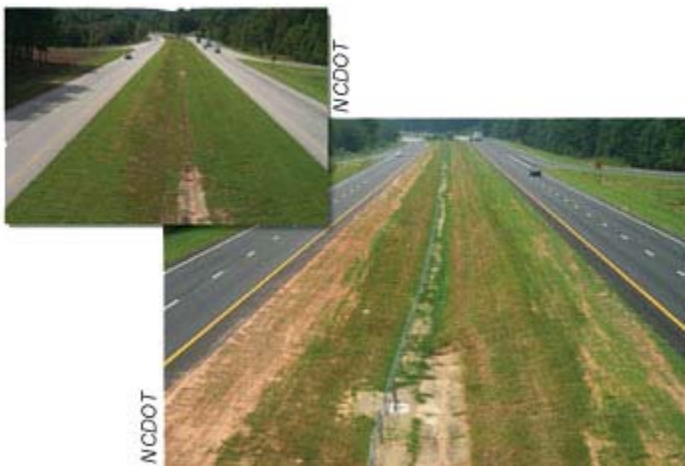
Cable median barrier designs have been tested in accordance with the National Cooperative Highway Research Program's *NCHRP Report 350* Test Level 3. Only a few studies, however, have been published about the inservice performance of this system.

The cable barrier system used by North Carolina consists of three steel 19-millimeter (0.74-inch)-diameter cables with steel supporting posts a maximum of 5 meters (16.4 feet) apart. The bottom cable height is 540 millimeters (21 inches) from the ground; the top cable height is 840 millimeters (33 inches) from the ground. Anchor post brackets and breakaway anchor angles secure each end of the cable run. The maximum distance between anchors is 600 meters (1,968 feet). The cable tension is controlled by spring turnbuckles located near each end of the cable run.

In addition to the "generic" cable barrier system described above, there are now several proprietary designs that have also successfully met Report 350 evaluation criteria. These are characterized by the use of prestretched cables that are then installed with significantly greater cable tension than in the original design. These modifications are intended to reduce deflection in a crash and to require less repair afterwards in many instances.

Chapter 6 of the guide states that a barrier traditionally is not warranted in medians wider than 10 meters (30 feet). AASHTO further recommends that installing barriers on medians from 10 to 15 meters (30 to 50 feet) should be optional. Agencies typically do not install barriers for those optional situations because of the need for cost savings. Based on research in their own States, California and North Carolina suggested that any medians with widths up to 23 meters (75 feet) could warrant barriers, depending on specific crash histories. Because of initiatives taken by California, North Carolina, and several other State DOTs, the AASHTO Technical Committee for Roadside Safety currently is revising the *Roadside Design Guide* warrants and plans to have more conservative warrants in place in 2005.

Most recently, AASHTO named the median barrier a Technology Implementation Group Focus Technology. As a focus technology, the median barrier will be promoted to AASHTO member departments and the highway community, aiding in the expansion of the technology to other areas of the country. Efforts to promote the technology will likely include speaker presentations, demonstration workshops, and the development of instructional brochures and CD-ROMS, among other methods of building awareness within the transportation community. North Carolina will also most likely serve as the lead State for the focus technology team, which may include representatives from several State DOTs, FHWA, private sector companies, and academia.



U.S. 64 in Franklin County, NC, before (inset) and after installation of a cable barrier. The guardrail was installed as part of a repaving and shoulder rehabilitation project.

Phase 3—Preventing the Future Construction of Highways with Unprotected Narrow Medians. NCDOT adopted a new design policy in 1998 to prevent the construction of highways with unprotected median width of less than 21 meters (70 feet). Highways with narrow medians can still be constructed as long as median barriers are included as part of their design.

Results in Dollars Spent And Lives Saved

Median barriers clearly have achieved their objective of reducing cross-median crashes and saving lives. Although property damage cost has increased as a result of the barrier placement, NCDOT estimates that 96 lives were saved from January 1999 to December 2003 alone, resulting in an estimated crash cost savings of more than $290 million.

The department's cost-benefit analysis indicates that the program already has paid for itself in lives saved. Installation of cable barriers costs approximately $55,000 per mile in materials and labor, and New Jersey concrete barriers cost between $900,000 and $1.4 million per mile, depending on median width. There have been a few fatal cross-median crashes since installation of the barriers, but the number is significantly lower than it was prior to installation of the barriers. As one may expect, there have been many reported hits on the barriers and an increase in single vehicle crashes.

To date, the installation of median barriers has resulted in:

1. An estimated 90-percent reduction in freeway cross-median crashes
2. Approximately 25 to 30 lives saved each year
3. Hundreds of injuries prevented or reduced in severity
4. Savings of millions of dollars in crash costs annually

"As we build and maintain the State's network of highways, safety is the department's number one priority," says North Carolina Transportation Secretary Lyndo Tippett. "We're very pleased by these findings, and that's why we will continue to place a high priority on installing these life-saving devices along the State's highways."

Median barriers have saved lives in North Carolina, and they offer a promising solution for other States across the Nation. After seeing the success of the program pioneered in North Carolina, several other States currently are implementing the same median barrier technology. As more States realize the important role that median barriers play in preventing crashes, this life-saving device will undoubtedly become a mainstay in highway systems throughout the Nation.

For the future, NCDOT plans to continue seeking innovative solutions to address highway safety. To this end, the department has formed an Executive Committee for Highway Safety to research and develop solutions to other pressing safety issues such as lane departures and motorist behaviors that contribute to crashes on the highways. This diverse, multiagency committee includes membership from FHWA, the University of North Carolina Highway Safety Research Center, and the State Highway Patrol as well as NCDOT. In addition to the implementation of the median barrier program, NCDOT is expanding the use of other roadside technologies, such as rumble strips along the highways, to ensure that citizens are protected and traffic stays on the right side of the road.

Gary Strasburg is now the media spokesman for the Minerals Management Service in the U.S. Department of the Interior. Prior to that, he was a public affairs specialist with FHWA's Resource Center in Atlanta. He held that position for nearly 3 years, bringing with him a wealth of experience as a public affairs officer with the Air Force Reserve. This article was his last effort before moving onto his new position. He can be contacted at gary.strasburg@mms.gov or 202–208–3985.

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