National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: February 23, 2006

In reply refer to: H-06-12

Mr. J. Richard Capka
Acting Administrator
Federal Highway Administration
400 Seventh Street, S.W.
Washington, D.C. 20590

On May 1, 2003, about 2:11 a.m., eastern daylight time, a 1998 Mercedes Benz CLK320 (Mercedes), driven by a 34-year-old off-duty police officer, was traveling southbound on U.S. Route 1 (U.S. 1) through the city of Linden in Union County, New Jersey.[1] The vehicle was traveling in the right lane of a six-lane divided highway. The weather was clear, and the roadway was dry, except for a puddle of water adjacent to a service station on the west side of the roadway.

Near milepost (MP) 41.4, the Mercedes, traveling 48 to 62 mph, hit the curb on the west side of the road and swerved to the left. The Mercedes crossed the other two southbound lanes; mounted and crossed an 11.5-foot-wide, 6-inch-high raised concrete curb median; and entered the northbound lanes, where it collided head on with a 1986 Ford Taurus (Ford) traveling in the left northbound lane. The Mercedes rolled up and over the Ford and landed on its roof. The Mercedes slid approximately 80 feet across the northbound lanes and struck a wooden utility pole next to the east side of the roadway, where it came to rest straddling the right northbound lane and the grassy area to the east of the roadway. Following the collision, the Ford remained upright, rotated about 163 degrees counterclockwise, and slid about 50 feet, where it came to rest in the right northbound lane.

During the accident sequence, the Mercedes' contact with the raised median caused the vehicle to rotate about its longitudinal axis. A postcrash examination of the vehicles revealed that the right-front fender of the rotating Mercedes made contact with the Taurus' driver-side A-pillar. As a result, the crash forces were primarily directed into the passenger compartment of the Ford, dramatically increasing the severity of the crash.

The Ford was occupied by a 33-year-old driver and four passengers ranging in age from 18 to 31. The Mercedes driver, the Ford driver, and three of the four Ford Taurus passengers died at the scene. The fourth Ford passenger died several hours later in a hospital.

[1] For more information, read National Transportation Safety Board, *Passenger Vehicle Median Crossover and Head-On Collision With Another Passenger Vehicle, Linden, New Jersey, May 1, 2003,* Highway Accident Report NTSB/HAR-06/02 (Washington, DC: NTSB, 2006).

The National Transportation Safety Board determines that the probable cause of this accident was the Mercedes driver's loss of control of the vehicle due to alcohol impairment. Contributing to the severity of the accident were the lack of barriers separating traffic in the northbound and southbound traffic lanes and the failure of the Mercedes driver to wear his seat belt.

The accident occurred on U.S. 1 near MP 41.4 in the city of Linden, Union County, New Jersey. This section of U.S. 1 is a divided, two-way, six-lane asphalt-paved roadway (three lanes designated for northbound traffic and three lanes designated for southbound traffic), extending in a northeast/southwest direction. Slightly north of the accident site, the southbound lanes transitioned from four lanes to three. The northbound and southbound lanes are divided by an 11.5-foot-wide raised median with 6-inch-high Portland cement concrete curbing. (See photograph that follows.)

Raised curbed median near accident location.

There was no median barrier at the accident site. A New Jersey-type median barrier begins about 200 feet north of the accident site and continues north toward the Interstate 278 (I-278) interchange. This barrier was installed during the construction of the I-278 interchange in the late 1960s. Another median barrier was installed south of the accident location beginning at MP 39.4 in the town of Rahway. Physical evidence found on both median barriers during the Safety Board's investigation, such as the black tire rubber smears and metallic scrapes, suggests vehicle contact with these taller structures.

The segment of U.S. 1 that passes through the city of Linden is the only segment of U.S. 1 without a median barrier from Newark Airport to the Garden State Parkway, a distance of about 11 miles. The New Jersey Department of Transportation (NJDOT) offered a number of possible reasons for the lack of a median barrier at the accident site: the segment's straightness, the difficulty in safely terminating the segment's barrier ends, and the lack of recent reconstruction projects in the area.

The American Association of State Highway and Transportation Officials' (AASHTO's) *Roadside Design Guide*[2] defines median barriers as "longitudinal barriers that are most commonly used to separate opposing traffic on a divided highway." According to the *Roadside Design Guide*, median barriers should be installed only if the consequences of striking a barrier are expected to be less severe than if no barrier existed. Guidance contained in the *Roadside Design Guide* for the installation of barriers on high-speed,[3] controlled-access roadways that have relatively flat, traversable medians is based on a combination of average daily traffic (ADT) and center median widths. The *Roadside Design Guide* suggests that the need for median barriers be evaluated on roadways where the ADT is at least 20,000 vehicles and the median width is less than 10 meters (32.8 feet). Barriers are optional for roadways where the median width is less than 10 meters and the ADT is 30,000 or fewer vehicles. Barriers are also considered optional for median widths between 10 and 15 meters (41.2 feet), regardless of the ADT. Barriers are not normally considered for medians 15 or more meters wide. The section of U.S. 1 where the accident occurred had an estimated ADT exceeding 66,000 vehicles and a median width of 11.5 feet.

The *Roadside Design Guide* states that median barriers are sometimes used on high-volume, non-access-controlled roadways. It also notes that terminating such barriers can be difficult, and sight distance may be a significant problem at intersections. AASHTO's *A Policy on Geometric Design of Highways and Streets* (Green Book) further explains,

> Careful consideration should be given to the installation of median barriers on multilane expressways or other highways with partial control of access. Even medians that are narrow permit inadvertent encroachments with a chance of recovery and can also include geometric features to accommodate crossing or left-turn traffic. With the addition of barriers, barrier ends at median openings present formidable obstacles. Crash cushions, although needing maintenance and imposing a high initial cost, may be needed to shield an errant motorist from the barrier ends. Consequently, an evaluation of the number of median openings, crash history, alignment, sight distance, design speed, traffic volumes, and median width should be conducted prior to installation of median barriers on non-freeway facilities.[4]

The AASHTO guidelines, which the NJDOT has adopted, suggest that raised curb medians, such as the one present at the accident site, are best used on low-speed urban arterial roadways to prevent midblock left turns and provide a place for pedestrians and signs.[5] The AASHTO guidelines also note that on high-speed roadways, striking a raised median curb can

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[2] American Association of State Highway and Transportation Officials, *Roadside Design Guide* (Washington, DC: AASHTO, 2002).

[3] Both AASHTO's *A Policy on Geometric Design of Highways and Streets* and the Federal Highway Administration's (FHWA's) *Manual on Uniform Traffic Control Devices* use the terms "low speed" and "high speed" but do not define them. Interviews with veteran traffic engineers indicate that 45 mph is widely considered to be the boundary between low- and high-speed facilities. For further information, see *A Policy on Geometric Design of Highways and Streets* (Washington, DC: AASHTO, 2004) and *Manual on Uniform Traffic Control Devices* (Washington, DC: FHWA, 2003).

[4] *A Policy on Geometric Design of Highways and Streets* (2004), chapter 4.

[5] *A Policy on Geometric Design of Highways and Streets* (2004) and *Roadside Design Guide* (2002).

cause a driver to lose control, with the vehicle contacting the curb tripping, overturning, or becoming airborne, as was the case in this accident. Although the portion of U.S. 1 where the accident occurred had a posted 40-mph speed limit, traffic surveys showed that vehicles routinely traveled at substantially greater speeds.

The Safety Board concludes that a raised curb median, such as the one on U.S. 1 in the vicinity of the accident, is not sufficient to prevent crossover median accidents and can cause a vehicle to become out of control or airborne at the speeds at which vehicles travel on that segment of roadway. The Safety Board further concludes that had a median barrier been present at the accident site, the Mercedes probably would not have crossed from the southbound lanes into the northbound lanes and collided with the Ford.

Although the NJDOT has adopted AASHTO median barrier warrants as part of the State's *Roadway Design Manual*, AASHTO guidelines do not always accommodate New Jersey requirements; where discrepancies exist, the NJDOT guidelines are followed for all roadways except interstate highways. NJDOT guidelines state that the number of crossovers, accident history, alignment, sight distance, design speed, traffic volume, and median width should be evaluated before median barriers are installed on noninterstate highways.[6] As a practice, the NJDOT does not place median barriers on nonfreeway roadways that permit left turns.

The NJDOT's *Roadway Design Manual* also suggests that a number of factors be considered before installing median barriers on highways with partial control of access, in part, because of potential problems at each intersection or median crossover where the median barrier must be terminated. Safety Board staff observed numerous median barrier wall terminations on U.S. 1, which varied from elaborate crash cushions to no end treatment.

In October 2002, the NJDOT developed the "Cross Median Crash Reduction Program," which evaluates the accident history of roadway segments to help determine where to install median barriers. The program identified an initial list of freeway segments for further consideration. Because the program did not evaluate nonfreeway segments, U.S. 1 was not considered as a possible location to place a barrier. The NJDOT expects the program to be expanded, pending future funding, to include the entire State roadway network.

Following the accident, the NJDOT evaluated the accident site for the installation of a median barrier. For several reasons, including the low occurrence of median crossover accidents and the straight alignment of the roadway segment, the NJDOT determined that a median barrier was not needed for this segment of U.S. 1.

Determining whether a median barrier should be installed on roadways that have relatively flat, traversable medians, such as the accident roadway, is difficult because AASHTO guidelines for median barrier installation do not provide clear guidance. AASHTO's *Roadside Design Guide* provides guidance for the installation of median barriers on high-speed, controlled-access roadways based on a combination of ADT and center median widths. Because the section of U.S. 1 where the accident occurred had an estimated ADT exceeding 66,000 vehicles and a median width of 11.5 feet, the *Roadside Design Guide* would suggest that the

[6] New Jersey Department of Transportation, *Roadway Design Manual*, Section 8, "Guidelines for Guide Rail Design and Median Barriers."

roadway be evaluated as to the need for a median barrier. However, these guidelines do not state how to conduct such an evaluation or suggest specific information to consider. The *Roadside Design Guide* also states that median barriers are sometimes used on high-volume, non-access-controlled roadways but provides no specific guidance about median barrier installation other than information pertaining to the potential hazards in terminating barrier ends and sight distance. For such roadways, AASHTO's *A Policy on Geometric Design of Highways and Streets* (as adopted by New Jersey) suggests several factors to consider in installing a median barrier on multilane expressways or other highways with partial control of access: the number of median openings, accident history, alignment, sight distance, design speed, traffic volumes, and median width. However, specific guidance is lacking concerning the conditions warranting the installation of median barriers, such as the level of traffic volume, number or rate of accidents, sight distance, or median width measurements.

The Safety Board has previously asked the FHWA and AASHTO to revise the median barrier guidelines to reflect changes in the factors affecting the probability of cross-median accidents.[7] Specifically, the Safety Board recommended that the FHWA, in conjunction with AASHTO (Safety Recommendation H-98-24):

> H-98-12
> Review, with the American Association of State Highway and Transportation Officials, the median barrier warrants and revise them as necessary to reflect changes in the factors affecting the probability of cross-median accidents, including changes in the vehicle fleet and the percentage of heavy trucks using the roadway.

AASHTO has informed the Safety Board that it is revising the guidance for median barriers. When completed, it is expected that the guidance will be released as an updated chapter in the *Roadside Design Guide*.[8] The Safety Board looks forward to the opportunity to review this additional guidance; until then, Safety Recommendations H-98-12 and -24 remain classified "Open—Acceptable Response."

As traffic, congestion, and vehicle speeds increase on roadways similar to the accident roadway, the probability of a median crossover accident also increases. The Safety Board recognizes that the installation of median barriers on roadways entails a complex decision-making process involving a number of roadway characteristics, a process made more difficult by the fact that the current median barrier installation guidelines are inadequate for determining when to install a median barrier. The Safety Board concludes that the AASHTO guidelines for the installation of a median barrier are inadequate because they do not include specific guidance on how to evaluate highway factors, such as accident history, sight distance, and vehicle type or speed, to determine whether a median barrier is necessary. The Safety Board believes that

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[7] (a) National Transportation Safety Board, *Ford Explorer Sport Collision With Ford Windstar Minivan and Jeep Grand Cherokee on Interstate 95/495 Near Largo, Maryland, February 1, 2002*, Highway Accident Report NTSB/HAR-03/02 (Washington, DC: NTSB, 2003). (b) National Transportation Safety Board, *Multiple Vehicle Crossover Accident, Slinger, Wisconsin, February 12, 1997*, Highway Accident Report NTSB/HAR-98/01 (Washington, DC: NTSB, 1998).

[8] AASHTO plans full review of the *Roadside Design Guide*, culminating in a fully updated guide, possibly in 2008 (March 16, 2005, e-mail from the Associate Program Director, Engineering, AASHTO).

AASHTO and the FHWA should work together to establish evaluative criteria for determining when to install median barriers on high-volume, high-speed roadways, regardless of access type.

The National Transportation Safety Board therefore makes the following recommendation to the Federal Highway Administration:

> Work with the American Association of State Highway and Transportation Officials to establish evaluative criteria for determining when to install median barriers on high-volume, high-speed roadways, regardless of access type. (H-06-12)

The Safety Board also issued safety recommendations to AASHTO and the city of Linden, New Jersey, and reiterated a previously issued recommendation to the State of New Jersey. Please refer to Safety Recommendation H-06-12 in your reply. If you need additional information, you may call (202) 314-6177.

Acting Chairman ROSENKER and Members ENGLEMAN CONNERS, HERSMAN, and HIGGINS concurred in this recommendation.

[Original Signed]

By: Mark V. Rosenker
Acting Chairman