



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: September 9, 2004

In reply refer to: H-04-31

Mr. John Horsley
Executive Director
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The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating transportation accidents, determining their probable cause, and making recommendations to prevent similar accidents from occurring. We are providing the following information to urge your organization to take action on the safety recommendation in this letter. The Safety Board is vitally interested in this recommendation because it is designed to prevent accidents and save lives.

This recommendation, which addresses motorist warning systems, is derived from the Safety Board's investigation of the May 26, 2002, allision between the towboat *Robert Y. Love* and the Interstate 40 highway bridge (I-40 bridge)¹ and is consistent with the evidence we found and the analysis we performed. As a result of this investigation, the Safety Board has issued four new safety recommendations, one of which is addressed to the American Association of State Highway and Transportation Officials (AASHTO). Information supporting this recommendation is discussed below. The Safety Board would appreciate a response from you within 90 days addressing the actions you have taken or intend to take to implement our recommendation.

About 7:45 a.m., on May 26, 2002, the towboat *Robert Y. Love*, pushing two empty asphalt tank barges, was traveling northbound on the McClellan-Kerr Arkansas River Navigation System (M-KARNS) near Webbers Falls, Oklahoma. As the tow approached the I-40 bridge at mile 360.3, it veered off course and rammed a pier 201 feet west of (outside) the navigation channel. The impact collapsed a 503-foot section of the bridge, which fell into the river and onto the barges below. According to witnesses, highway traffic continued to drive into the void in the bridge created by the collapsed spans. When traffic stopped, eight passenger vehicles and three truck tractor-semitrailer combinations had fallen into the river or onto the collapsed portions of the bridge. The accident resulted in 14 fatalities and 5 injuries and caused an estimated \$30.1 million in damage to the bridge, including the operation of detours, and \$276,000 in damage to the barges.

¹ For more information, read National Transportation Safety Board, *U.S. Towboat Robert Y. Love Allision With Interstate 40 Highway Bridge Near Webbers Falls, Oklahoma, May 26, 2002*, Highway Accident Report NTSB/HAR-04/05 (Washington, DC: NTSB, 2004).

The National Transportation Safety Board determined that the probable cause of the *Robert Y. Love's* collision with the Interstate 40 highway bridge and its subsequent collapse was the captain's loss of consciousness, possibly as the result of an unforeseeable abnormal heart rhythm. Contributing to the loss of life was the inability of motorists to detect the collapsed bridge in time to stop their vehicles.

In this accident, 11 vehicles either fell with the collapsed sections of the bridge or drove off the bridge and into the void. The surviving drivers indicated that they could not see the void in the bridge in time to avoid driving into it. The Safety Board examined the available sight distance for both passenger cars and tractor-semitrailers on the eastbound and westbound approaches to the void in the bridge. The sight distances ranged from 150 to 350 feet; the minimum total stopping distance² at 70 mph (the posted speed limit at the accident site) for passenger cars was 622 feet and for tractor-semitrailers was 726 feet. The minimum total stopping distance for a tractor-semitrailer traveling at 57 mph (self-reported by one driver) was 514 feet. These total stopping distances are greater than the maximum estimated distance of 350 feet for the first point of possible perception, indicating that some drivers involved in this accident did not have sufficient time to stop their vehicles after detecting the collapsed sections of the bridge. In light of the statements of surviving drivers, estimates of the point of first possible perception, and calculations of total stopping distance, the Safety Board concluded that the drivers in this accident did not have adequate time to detect, identify, and respond to the hazard posed by the collapsed sections of the bridge.

An effective motorist warning system, mounted on or near the bridge and capable of alerting motorists to the bridge failure or directing vehicles to stop, might have prevented some of the vehicles, the majority of which were traveling westbound, from driving off the I-40 bridge. Because westbound vehicles, traveling at 57 to 75 mph, could have traversed the 1,500 feet from the east end of the bridge to the void in 13 to 18 seconds, it can be argued that had warning signs been activated within a few seconds, several of the westbound vehicles probably would have had time to react to the warning signs and stop before driving off the bridge.

A participant in a fishing tournament nearby, who fired a flare pistol to warn the driver of a westbound tractor-trailer truck of the hazard, said that he saw at least one vehicle fall with the bridge and that he then accelerated his boat toward the bridge and reached the area in about 20 seconds. He also stated that he saw two more vehicles drive off the bridge before he called 911; after the call, he saw five more vehicles drive off the bridge before shooting the flare. It is difficult to estimate exactly how much time elapsed between the collapse and the time the truckdriver saw the flare, stopped, and blocked the westbound approach with his truck. Further, only by coincidence did this recreational boater witness the accident and have the presence of mind to fire a warning flare. The first emergency responder arrived in 8 minutes, so, certainly, in the absence of a fishing tournament or other witnesses to the bridge collapse, an effective warning system would have stopped additional vehicles from driving off the bridge. The Safety Board therefore concluded that the quick-acting fisherman who fired the warning flare to alert motorists on the bridge probably prevented further loss of life. The Safety Board further concluded that an effective motorist warning system on the I-40 bridge might have mitigated the loss of life in this accident.

² Includes perception/reaction and braking distances.

The Texas Department of Transportation installed such a motorist warning system after the 2001 Queen Isabella Causeway accident,³ in which 10 vehicles either collapsed with the bridge or drove off the void, resulting in eight fatalities. This early warning collapse detection system, which became operational in March 2004, consists of fiber-optic cable, which, if severed, activates flashing lights to warn motorists of danger ahead.

The Safety Board acknowledges that protecting all bridges against all extreme events such as vessel or vehicle impacts, flooding (including scour and debris loading), seismic events, and terrorist attacks, is not possible. Bridge protection is a multitiered process. When physical protection is not possible, methods that mitigate the loss of life become necessary. In the case of long bridges with many vulnerable piers, such as the Queen Isabella Causeway, or bridges with curvature that results in sight distance limitations, such as the I-40 bridge, it is critical to protect the motoring public by installing automatic bridge failure detection and warning devices.

The Safety Board has addressed the installation of bridge motorist warning systems in previous accident investigations involving the Lake Pontchartrain Causeway, Sunshine Skyway Bridge, and Sidney Lanier Bridge.⁴ The Board is aware of at least one discontinuity warning system that has been installed since these accidents, the one on the Sunshine Skyway Bridge in Florida, which the Florida Department of Transportation has characterized as being unreliable. The Federal Highway Administration (FHWA) is working to improve the reliability of such systems, specifically the ability of long-term monitoring instrumentation to withstand the conditions typically found on bridges, through its March 2004 Structural Health Monitoring initiative and through continuing Intelligent Transportation Systems programs.

The development of reliable long-term sensing technology is critical in protecting the motoring public, and the Safety Board encourages the FHWA to continue its efforts to provide reliable motorist warning systems. Furthermore, once a reliable long-term detection system has been developed, the Safety Board believes that the FHWA should encourage the States to deploy this technology in comprehensive motorist warning systems; such systems could also be used on bridges vulnerable to collapse from other circumstances such as scour, seismic events, and terrorist attack. The Safety Board has therefore recommended that the FHWA develop an effective motorist warning system to stop motor vehicle traffic in the event of a partial or total bridge collapse. In addition, although the Vessel Collision Guide Specifications⁵ describe motorist warning systems and reference the 1983 FHWA technical advisory,⁶ neither the specifications nor the technical advisory provide guidance on the use of motorist warning systems.

³ NTSB docket number HWY-01-I-H036.

⁴ (a) National Transportation Safety Board, safety recommendation letter to the Greater New Orleans Expressway Commission, January 8, 1975, notation 1423; (b) National Transportation Safety Board, *Ramming of the Sunshine Skyway Bridge by the Liberian Bulk Carrier Summit Venture, Tampa Bay, Florida, May 9, 1980*, Marine Accident Report NTSB/MAR-81/03 (Washington, DC: NTSB, 1981); (c) National Transportation Safety Board, SS African Neptune: *Collision With the Sidney Lanier Bridge at Brunswick, Georgia, on November 7, 1972, With Loss of Life*, Marine Accident Report USCG/NTSB/MAR-74/04 (Washington, DC: NTSB, 1974).

⁵ American Association of State Highway and Transportation Officials, *Guide Specification and Commentary for Vessel Collision Design of Highway Bridges* (Washington, DC: AASHTO, 1991).

⁶ Federal Highway Administration, "Pier Protection and Warning Systems for Bridges Subject to Ship Collisions," Technical Advisory T5140.19 (Washington, DC: FHWA, 1983).

The National Transportation Safety Board therefore makes the following recommendation to the American Association of State Highway and Transportation Officials:

Once an effective motorist warning system has been developed, provide guidance to the States on its use. (H-04-31)

The Safety Board has been working since the 1970s to address the vulnerability of bridges to vessel impact.⁷ The vulnerability of existing bridges to vessel impact was discussed extensively in the Safety Board's report of the 1993 towboat *Chris* allision with the Judge William Seeber Bridge in New Orleans, Louisiana,⁸ in which the Safety Board made the following recommendation to AASHTO:

H-94-9

In cooperation with the Federal Highway Administration, broaden the application of risk-assessment and management programs to existing highway bridges. Such programs should include, among other things, a formal assessment of the vulnerability of bridges to vessel collision and collapse.

On December 8, 1994, AASHTO responded, noting that this recommendation was under active consideration by the Standing Committee on Highways' Subcommittee on Bridges and Structures and would be discussed in depth at the May 1995 meeting of the subcommittee. In its June 20, 1995, reply, the Safety Board acknowledged the above and classified Safety Recommendation H-94-9 "Open—Acceptable Response."

At a meeting with Safety Board staff on March 30, 2004, AASHTO indicated that it is investigating additional countermeasures as part of its work on the security and vulnerability assessments of the transportation systems. The Water Transportation Committee also discussed this issue with Safety Board staff at its July 2003 meeting and said it will work with the Standing Committee on Highways' Subcommittee on Bridges and Structures on risk assessment issues.

The Safety Board is disappointed that after 10 years, AASHTO has not yet addressed the vulnerability of *existing* bridges to vessel impact and collapse. In a July 20, 2004, letter to AASHTO, the Safety Board indicated Safety Recommendation H-94-9 remained classified "Open—Acceptable Response." However, given that the intent of Safety Recommendation H-94-9 is covered by Safety Recommendation H-04-29 to the Federal Highway Administration to revise the sufficiency rating system, issued as a result of this investigation, Safety Recommendation H-94-9 is reclassified "Closed—Superseded."

The Safety Board also issued another safety recommendation to the Federal Highway Administration and one to the U.S. Coast Guard. Please refer to Safety Recommendation H-04-31 in your reply. If you need additional information, you may call (202) 314-6177.

⁷ See appendix C in NTSB/HAR-04/05 for more information on related recommendations.

⁸ National Transportation Safety Board, *U.S. Towboat Chris Collision With the Judge William Seeber Bridge New Orleans, Louisiana, May 28, 1993*, Highway-Marine Accident Report NTSB/HAR-94/03 (Washington, DC: NTSB, 1994).

Chairman ENGLEMAN CONNERS, Vice Chairman ROSENKER, and Members CARMODY, HEALING, and HERSMAN concurred in this recommendation.

By: Ellen Engleman Connors
Chairman