Log H-525

NATIONAL TRANSPORTATION SAFETY BOARD

Washington, D.C. 20594

Safety Recommendation

Date: May 4, 1994

In Reply Refer To: H-94-5 and -6

Honorable Rodney E. Slater
Administrator
Federal Highway Administration
400 Seventh Street, SW
Washington, D.C. 20590

On May 19, 1993, at 1:35 a.m., a 1989 Navistar International cab-over-engine tractor with bulk-cement-tank semitrailer[1] was traveling southbound on Interstate 65 (I-65) near Evergreen, Alabama. About 300 feet north of the County Road 22 overpass crossing I-65, the cement truck left the right pavement edge. The tractor overran the W-beam guardrail in front of the overpass two-column bent. The semitrailer collided with and demolished the north column; however, the south column remained upright but tilted toward the south. Two spans of the overpass that were supported by the bent collapsed onto the semitrailer and the southbound lanes of I-65. The tractor had traveled under and cleared the overpass before it came to rest on I-65. An automobile and a tractor-semitrailer, also southbound, subsequently collided with the fallen bridge spans. The cement-tank truckdriver was seriously injured; the drivers of the other two vehicles were killed.[2]

The bridge overpass was constructed in 1961 and conformed to design guidelines at the time. The spans, a noncontinuous concrete deck supported by steel girders, were supported by three two-column bents and two abutments. Each column measured 2.5 feet by 3 feet, and the

[1]The gross vehicle weight of the truck and the cement was about 78,780 pounds.

[2]For more detailed information, read Highway Accident Report--*Tractor-Semitrailer Collision with Bridge Columns on Interstate 65 near Evergreen, Alabama, on May 19, 1993* (NTSB/HAR-94/02).

3-foot face was parallel to the road. The columns in the collision were 8 feet from the edge of the shoulder. The W-beam guardrail, which flared away from the traveled way, was installed in front of the columns in 1989.

The bridge collapsed because the semitrailer collided with and demolished the north column of a two-column bent that supported the County Road 22 overpass. The location of the columns, 8 feet from the road, made them vulnerable to a vehicle collision. Current design guidelines[3] recommend the placement of bridge columns, where feasible, 30 feet or more from the edge of the traveled way. Bridge columns within this 30-foot clear zone can either be protected from collision or have the damage from the collision minimized by the placement of appropriate protective devices. Most traffic barriers, such as the W-beam guardrail in front of the columns that supported the County Road 22 overpass, are designed primarily to protect passenger cars from roadside obstacles. However, some high performance barriers can provide improved bridge column protection as well as protect heavy vehicles, such as tractor-semitrailers, from roadside obstacles. The location of the columns in this accident, within the 30-foot clear zone and with only W-beam guardrail protection, made the columns vulnerable to a high-speed heavy-vehicle collision. (Passenger cars that typically weigh between 2,000 and 3,000 pounds do not pose the same threat to bridge substructures as heavy commercial vehicles that weigh between 26,000 and 80,000 pounds.)

Redundancy can be designed into a bridge so the loss of a substructure element, such as the north column in this accident, will not necessarily result in the collapse of the bridge. During a bridge failure, loads previously carried by the failed substructure member can be redistributed throughout a redundant substructure to other support members. However, the simply supported spans and the nonredundant design of the substructure in the County Road 22 overpass made the bridge vulnerable to collapse. The importance of redundancy in bridge design was discussed in the National Transportation Safety Board report on the April 1987 Schoharie Creek bridge accident.[4] Further, the Safety Board is presently investigating two other accidents involving bridges in which vulnerability is also an issue. The bridges did not have a redundant design, nor was it required. On May 28, 1993, a one-barge tow collided with a column of a two-column bent that supported four spans of a four-lane highway bridge over a canal in New Orleans, Louisiana. The column collapsed, and subsequently, the other column and two spans fell into the water, killing one person in an automobile. Present bridge design guidelines, such as in the American Association of State Highway and Transportation Officials (AASHTO) 1992 *Standard Specifications for Highway Bridges*, recommend load path, structural, or internal redundancy. However, many of the approximately 577,000 highway bridges in the United States were neither designed nor constructed with redundancy.

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[3]*Standard Specifications for Highway Bridges*, 15th Edition, 1992, American Association of State Highway and Transportation Officials.

[4]Highway Accident Report--*Collapse of New York Thruway (I-90) Bridge Over the Schoharie Creek, Near Amsterdam, New York, April, 5, 1987* (NTSB/HAR-88/02).

Numerous highway bridges throughout the United States are of similar design to the bridge in this accident and have one- or two-column supports that are often located within the 30-foot clear zone and are at risk from high-speed heavy-vehicle collisions. National bridge inventory (NBI) data, maintained by the Federal Highway Administration (FHWA), can identify the bridges that pass over roads traveled at high speed and can provide the average daily truck traffic count on these roads. However, the NBI data do not identify substructural design, redundancy in design, the proximity of substructure members to the road, or the type of protective traffic barriers adjacent to the substructure members. Therefore, the number of bridges vulnerable to high-speed heavy-vehicle collision can not be determined from the NBI data.

The National Highway Traffic Safety Administration (NHTSA) estimates that annually 1,000 trucks and buses (10,000 pounds gross weight or greater) collide with bridge structures. According to data from the NHTSA Fatal Accident Reporting System, heavy truck (26,000 pounds or greater) collisions with bridge piers or abutments in the years 1990-92, caused 18, 26, and 17 deaths, respectively; of these deaths, 13, 19, and 9, respectively, occurred on interstate highways. Heavy-vehicle collision with bridge columns is fairly common; however, no data indicate the frequency of bridge collapse from such collision, and subsequent bridge collapse appears to be an infrequent occurrence. Although it occurs infrequently, the result may be catastrophic when it does happen.

As a result of the Intermodal Surface Transportation Efficiency Act of 1991, enacted by Congress on December 18, 1991, States have begun developing bridge management systems.[5] AASHTO has published *Guidelines for Bridge Management Systems*, but these guidelines do not include means to determine which bridges have columns that might be vulnerable to heavy-vehicle collision or which bridges are likely to collapse from such impact. However, AASHTO bridge management guidelines could be modified to include them.

The Safety Board distributed a questionnaire to the 50 States in December 1993 to determine whether State transportation officials identify which bridge columns or spans are at risk from heavy-truck or vessel collisions and subsequent collapse. Twenty-two States have responded. None of the States reported evaluating the probability of pier or span collision and collapse from heavy-truck collisions. However, six[6] of the States noted that they assess the risk of collision and collapse of both piers and spans in new designs.

Based on the above information and discussions with the FHWA and State bridge engineers, the Safety Board concludes that State highway departments do not universally identify or assess bridge structures and their vulnerability to high-speed heavy-vehicle collision and

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[5]In section 1034, 303 (a)(2), the Secretary of Transportation was required to "issue regulations for State development, establishment, and implementation of a system for managing... bridges on and off Federal-aid highways."

[6]Kansas, Maine, Missouri, New Hampshire, Pennsylvania, and Vermont.

subsequent collapse. State transportation officials need to identify the existing bridges with columns that are vulnerable to high-speed heavy-vehicle collision, evaluate which of those bridges are likely to collapse, and implement suitable countermeasures. Therefore, the Safety Board believes that the FHWA should request States to identify and assess bridges that are vulnerable to collapse from a high-speed heavy-vehicle collision with their bridge columns and develop and implement countermeasures to protect the structures. In addition, the Safety Board believes that the FHWA and AASHTO, in cooperation, should ensure that the bridge management program guidelines include information on evaluating which bridges are vulnerable to high-speed heavy-vehicle collision and subsequent collapse.

Therefore, the National Transportation Safety Board recommends that the Federal Highway Administration:

> Request States to identify and assess bridges that are vulnerable to collapse from a high-speed heavy-vehicle collision with their bridge columns and develop and implement countermeasures to protect the structures. (Class II, Priority Action) (H-94-5)
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> In cooperation with the American Association of State Highway Transportation Officials, ensure that the bridge management program guidelines include information on evaluating which bridges are vulnerable to high-speed heavy-vehicle collision and subsequent collapse. (Class II, Priority Action) (H-94-6)

Also, the Safety Board issued Safety Recommendation H-94-7 to the American Association of State Highway Transportation Officials. If you need additional information, you may call (202) 382-6850.

Chairman VOGT and Members LAUBER, HAMMERSCHMIDT, and HALL concurred in these recommendations.

By: Carl W. Vogt
Chairman