SP-20
Log H-450

NATIONAL TRANSPORTATION SAFETY BOARD
WASHINGTON, D.C.

ISSUED: October 16, 1985

Forwarded to:

Honorable Ray Barnhart
Administrator
Federal Highway Administration
400 7th Street, S.W.
Washington D.C. 20590

SAFETY RECOMMENDATION(S)

H-85-27 through -29

About 2:01 p.m., c.s.t., on April 24, 1985, two 34-foot-long twin spans at the south end of the 450-foot-long Chickasawbogue Creek Bridge on U.S. 43 about 2 miles north of Mobile, Alabama, fell into water ranging from 10 to 30 feet deep after a steel pile bent 1/ collapsed. Two of three southbound vehicles on the bridge at the time stopped before reaching the edge of the bridge void. However, one vehicle, a 1979 Ford van, became airborne and struck one of the falling bridge spans and entered the water. The van's occupant sustained minor injuries but was able to exit the van and swim to shore before the van sank in 20 feet of water.

The two-way, four-lane bridge, which was built in 1958, had eleven 34-foot-long twin spans and one 72-foot-long twin main span. The two adjacent spans which fell were supported by the steel pile bent which collapsed. Ten 45-foot-long, steel H-piles forming the failed bent were encased in concrete from the bent cap to 3 feet below the normal water line and were connected together at the normal water line by a reinforced concrete strut. In a postaccident examination, divers for the State of Alabama reported that the exposed steel of the H-piles was severely corroded near the mud line of the creek. Moreover, all the other H-piles supporting the bridge exhibited varying stages of corrosion with the most corrosion occurring at the mud line.

The Safety Board obtained samples of a collapsed 10-inch steel H-pile near the mud line for a metallurgical examination. Corrosion had reduced the total cross section thicknesses of the web and flanges on the steel H-pile by about 54 percent. The estimated weight loss for the most severely corroded area of the steel H-pile sample was about 57 percent.

The State of Alabama discovered similar underwater corrosion in 1977 on three other bridges located closer to Mobile Bay and resolved the problem by encasing the steel piles in concrete from the water line to below the mud line on one bridge and by replacing steel piles with concrete piles on the two other bridges. These three bridges and the bridge over Chickasawbogue Creek are over brackish 2/ water which varies in salinity as the tide changes. State officials were aware of such variations in the vicinity of Mobile Bay, but were not aware that the salinity variations occurred also 12 miles upstream from Mobile Bay.

1/ A pile bent is a transverse structural framework composed of piles and a pile cap.
2/ Containing some salt.

The State of Alabama last inspected the Chickasawbogue Creek Bridge on April 3, 1985. However, none of the underwater bridge elements were examined, and State policy did not require them to be inspected. The State inspects all bridges at 2-year intervals in accordance with the National Bridge Inspection Standards (NBIS) 3/ and inspects the underwater elements of "major" 4/ bridges at 5-year intervals. The Chickasawbogue Creek Bridge was not classified as a major bridge, and the Safety Board was unable to find any evidence which indicated that the underwater elements of the bridge had been inspected since 1969.

As a result of the collapse of the bridge spans over Chickasawbogue Creek, the State of Alabama launched an intensive inspection and repair program that is estimated to be completed by December 1985. The State will inspect the underwater elements of 655 bridges and bridge culverts. Twenty of the bridges inspected exhibited varying stages of corrosion of the steel piles. Ten bridges were on interstate routes, and the remaining 10 bridges were on State routes. Excessive corrosion was found on exposed steel piles in both fresh and brackish water. The State indicated that it will continue to inspect the underwater elements of these bridges every 2 years after the intensive inspection program is completed.

Corrosion of exposed steel bridge piles is not unique to the State of Alabama. In December 1968, a portion of a 300-foot-long, two-lane bridge collapsed into the Anclote River in Florida near the Gulf of Mexico. Corrosion below the concrete encasement had reduced significantly the cross section of exposed steel H-piles near the splash zone. 5/ The State of Florida initiated an immediate program to inspect all bridges over water and found similar corrosion problems on several other bridges. Until the time of the Anclote River bridge collapse, Florida had not conducted underwater examinations. Because of the bridge collapse and subsequent inspection program findings, Florida adopted immediately a policy to inspect the underwater elements on all bridges over water at 2-year intervals.

The Federal Highway Administration (FHWA) reported in 1984 that there were about 547,045 highway bridges in the United States. 6/ Approximately 87 percent of these bridges were over water. Currently, there is no data available to estimate the number of bridges over water which are constructed with exposed steel H-piles. A study performed by the Transportation Research Board 7/ indicated that only 24 States inspect the underwater elements of bridges. Alabama is one of the 24 States listed. The study did not report whether the States inspected the underwater elements on all applicable bridges or just selected bridges during low water periods.

3/ Reference 23 CFR 650.301 to 650.311, "National Bridge Inspection Standards," for details.

4/ Although there is no universally accepted definition for a major bridge, the State of Alabama generally defines major bridges as bridges over major rivers with complex designs or foundations in deep water.

5/ The area on exposed steel piles where water droplets and water film continuously accumulate. This area is normally above the mean high water level for steel piles exposed to the atmosphere.

6/ U.S. DOT FHWA--"Sixth Annual Report to Congress on Highway Bridge Replacement and Rehabilitation Program," published April 1985.

7/ National Cooperative Highway Research Program Synthesis of Highway Practice 88 "Underwater Inspection and Repair of Bridge Substructures" Transportation Research Board, December 1981.

The NBIS requires all bridges to be inspected at 2-year intervals, but the depth or frequency to which particular elements of bridges are to be inspected is left to the discretion of the individual States. Bridge inspection guidelines are provided in the 1983 Manual for Maintenance Inspection of Bridges published by the American Association of State Highway and Transportation Officials (AASHTO). The manual suggests that underwater elements of piers should be inspected at 5-year intervals, and states that bridge inspectors should examine steel and concrete piles in the splash zone and below the water surface for corrosion and other deterioration. The 1970 Bridge Inspector's Training Manual published by the FHWA indicates that exposed steel H-piles have been found to be severely perforated at deep water depths and that "the inspection for corrosion on bridge elements in sea water is extremely important since sea water is four times as deleterious as fresh water."

Safety Board investigators contacted the Division Administrator and Division Structural Engineer in Alabama, and the Regional Structural Engineer in Atlanta, Georgia, officials of the FHWA responsible for ensuring compliance with the NBIS. The FHWA conducts an annual review of the State bridge inspection programs, renders technical assistance, and provides training in bridge inspection. None of the FHWA officials were aware that Alabama was not inspecting the underwater elements of non-major bridges. Safety Board investigators examined the Structure Inventory and Appraisal Sheet (SI&A) which the FHWA requires each State to complete for all bridges, and the bridge inspection report form used by the State of Alabama. Neither document provides for reporting whether the underwater elements were examined when each bridge was inspected.

Because of the serious issues raised by the collapse of a bridge and the apparent lack of uniform State policies governing the inspection of underwater elements on bridges, the Safety Board convened a public hearing in Atlanta, Georgia, on July 17, 1985 to focus public attention on these issues. During the course of the hearing, the Safety Board assembled a comprehensive factual record regarding information on the accident, looked at the adequacy of bridge inspection programs in several surrounding States, and identified factors influencing the corrosion of exposed steel piles in a marine environment. The investigation is continuing.

The Safety Board believes that the FHWA should require each State to conduct an inspection of the underwater structural elements on all applicable bridges which have not had such inspection within the 5-year interval suggested in the AASHTO Manual for Maintenance Inspection of Bridges. Because of the large variances in the environmental conditions to which the underwater structural elements of bridges are exposed, the FHWA should conduct research to establish appropriate inspection cycles for bridge elements in marine environments.

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

> Require all States to inspect the underwater structural elements on all applicable bridges that have not had such an inspection within the last 5 years. (Class II, Priority Action) (H-85-27)
>
> Revise the "Structure Inventory and Appraisal Sheet" form to include a specific entry which denotes if the underwater structural elements of a bridge have been inspected and the date of the last underwater inspection. (Class II, Priority Action) (H-85-28)

Conduct research to establish appropriate inspection cycles for the underwater structural elements of bridges that are exposed to a wide range of marine environments, and require States to institute a statewide program of corresponding periodic inspections of the underwater structural elements on all applicable bridges. (Class II, Priority Action) (H-85-29)

BURNETT, Chairman, GOLDMAN, Vice Chairman, and BURSLEY, Member, concurred in these recommendations.

By: Jim Burnett
Chairman