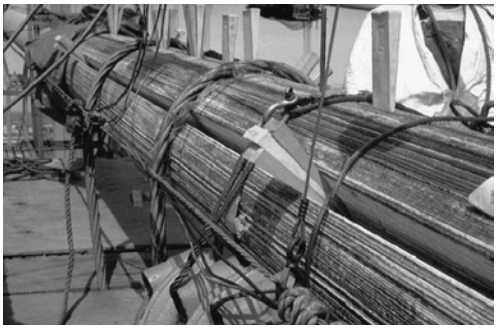
Bridge owners using inspection guidelines

Soaring suspension bridges are among the most recognizable landmarks across the United States. However, more than half of the country's major suspension bridges are older than 50 years, raising the question: How do engineers assure the bridges' continuing load-carrying capacity?



Cable wedged for inspection

Need for inspection guidelines

A 1998 NCHRP-sponsored workshop on safety appraisal of suspension bridges cited the pressing need for development of cable inspection, sampling and testing guidelines.

This recommendation led directly to the exhaustive work of Ron Mayrbaurl, principal at Weidlinger Associates, Inc., which was published in 2004 as NCHRP Report 534, *Guidelines for Inspection and Strength Evaluation of Suspension Bridge Parallel-Wire Cables.* "I think the key value of the report," Mayrbaurl says, "is that it defines an inspection model and test methods for wires – in writing. It gives bridge owners something to work with."

> "The report provides a road map for cable inspection where none existed in the past."

Denis Mulligan, District Engineer for the Golden Gate Bridge Highway and Transportation District, keeps a copy of Report 534 on his desk and plans to use it for future cable inspections. "The report provides a road map for cable inspection," says Mulligan, "where none existed in the past. I believe most folks are planning on using it the next time they open their cables."

Bundles of wires

Suspension bridge cables are composed of thousands of steel wires, each thinner than a pencil. These bundles of high tensile strength wires are what make it possible to support long-span suspension bridges.

The entire bundle is typically covered at the time of construction with tightly wrapped wires and a paint system, intended to keep water from penetrating the cable and causing corrosion. The coverings, however, make visual inspection of the cable wires a fairly complicated endeavor.

Scotland's Forth Road Bridge

> "I'm not sure that we would've opened the main cables if the report hadn't been available."

First use of the cable inspection guidelines of NCHRP Report 534 occurred in Scotland in 2004-2005 on the Forth Road Bridge, Europe's largest suspension bridge when it opened in 1964, with a central span (tower to tower) of 3,300 feet.

Barry Colford, Depute General Manager for the Forth Estuary Transport Authority, says there was "a degree of skepticism in Europe and the UK that we needed to look at the inside of main cables and that it actually could be done effectively."

However, he notes, "Not being able to see the 11,618 wires in the main cable meant that we were not carrying out principal inspection of perhaps the most crucial element of the bridge."

"I'm not sure," he continues, "that we would've opened the main cables if the report hadn't been available."

Charles Cocksedge, Technical Director for Faber Maunsell Consulting Engineers, the firm appointed to carry out the internal inspection of the cables, says that "as the Forth Road Bridge was considerably younger than many U.S. bridges inspected, there was an expectation that few problems would be found. However, this was not the case, and widespread corrosion plus some broken wires were found."

Forth Road Bridge

Ambassador inspection under way

Ranked as the world's largest suspension bridge when it was completed in 1929 (central span of 1,850 feet), the Ambassador Bridge connects Detroit, Mich., and Windsor, Ontario.

Inspection of the main cables is currently under way by Modjeski and Masters Consulting Engineers. Michael Borzok, project manager for the inspection, says that NCHRP Report 534 has been an essential tool in the investigation.

"I can point to a number of benefits from the report," says Borzok. "From a time standpoint, the guidance is helping us get things done more efficiently. It's helping us attain more uniformity – getting everybody on the same page and doing things by the book, so to speak."

> "Ultimately, the report should help bridge engineers improve on the state of the art."

"Ultimately," Borzok says, "the report should help bridge engineers improve on the state of the art."

Interested bridge owners can review NCHRP Report 534 on TRB's Web site at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_534.pdf and order a hard copy with CD-ROM from the TRB Bookstore at http://www.trb.org/bookstore/

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