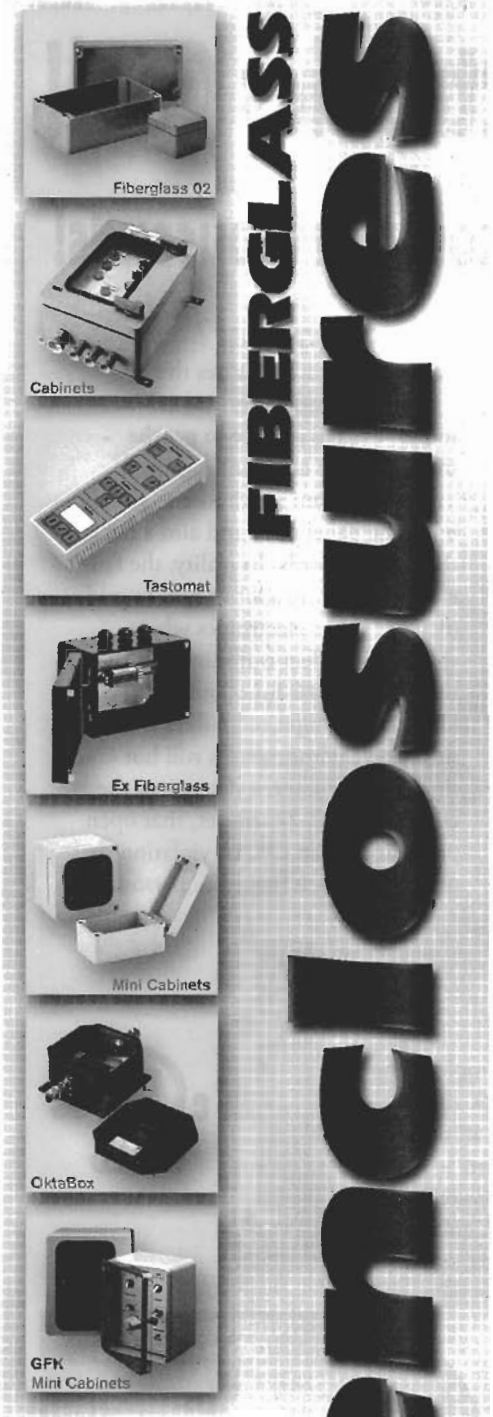

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Why bridges fail

The failure of the I-35W bridge in Minneapolis and the ceiling collapse of Boston's Big Dig tunnel have generated a lot of discussion about what causes major structural elements to just disintegrate. The origin of the I-35W disaster won't be known for some time, but history holds lessens about typical problems that can make bridges fail.

Insights come from the Technical Council on Forensic Engineering of the American Society of Civil Engineers. A rise in structural failures and performance deficiencies led the ASCE Council to study the problem in the 1980s and periodically thereafter. One difficulty it noticed was that designers were losing control over how construction projects were executed. Fast-track approaches to putting up structures saved time and money but made it easier for contractors and designers to misunderstand each other. Worse, they led to lines of responsibility during construction that were unclear.

The philosophy of cost cutting extended to the operation of buildings and other technically sophisticated structures. That has sometimes meant that there's no one around who could properly maintain complicated systems or inspect for hazardous conditions in an intelligent manner.

The ASCE additionally found it troubling that new materials and assembles were being promoted to designers who may simply fail to read directions.

Boston's Big Dig ceiling collapse could be a poster child for some of the problems that the ASCE identified. The National Transportation Safety Board found that builders had used the wrong epoxy to hold ceiling anchor bolts in place. Builders selected a brand that dried quickly — all the better, one might presume, to get the job done on a "fast track." They apparently didn't understand that the fast-set version would lose strength over time. The supplier of the epoxy knew about this property and simply assumed the builders knew about it too. Though construction managers noticed bolts slipping out of the ceiling as the tunnel went up, there were no regular inspections for more than three years after work finished.

Significantly, the ASCE as well saw a need for designs with better structural integrity. It specifically said that designers should plan for structural redundancy so that the failure of a single weight-bearing component wouldn't put the whole structure in jeopardy. And where redundancy wasn't possible, higher safety factors were in order.

Sadly, the I-35W bridge apparently lacked the kind of redundancy planning that is the norm today. Designed in the 1960s, it was conceived before the increased frequency of structural failures got ASCE's attention. Experts say its single-steel-arched construction lacked redundant structures and was unusual for the hundreds of feet it spanned without any ground support.

The only positive thing that can be said about the tragedy is that construction techniques that led to it went out of practice decades ago. As University of Pittsburgh engineering professor Kent Harries told the *Chicago Tribune*, "We know that we would not build a bridge like this today."

— Leland Teschler, Editor