U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON SCIENCE AND TECHNOLOGY

HEARING CHARTER

Bridge Safety: Next Steps to Protect the Nation's Critical Infrastructure

Wednesday, September 19, 2007
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

I. Purpose

On Wednesday, September 19, 2007 the Committee on Science and Technology will hold a hearing entitled *"Bridge Safety: Next Steps to Protect the Nation's Critical Infrastructure"* to examine research and development activities to improve the safety of the Nation's bridges. The hearing will explore the current state of bridge-related research, including government and academic research into materials, design elements, and testing and inspection technologies. Witnesses will also discuss future research priorities for building improved bridge infrastructure and maintaining current bridges to avoid catastrophic failure.

II. Witnesses

Mr. Dennis Judycki is the Associate Administrator for Research, Development, and Technology at the Federal Highway Administration (FHWA) of the U.S. Department of Transportation (U.S. DOT) and Director of U.S. DOT's Turner-Fairbank Highway Research Center (TFHRC).

Mr. Benjamin Tang is a Principal Bridge Engineer for the Office of Bridge Technology at the Federal Highway Administration of the U.S. DOT.

Dr. Kevin Womack is the Director of the Utah Transportation Center and Professor of Civil and Environmental Engineering at Utah State University.

Mr. Harry Lee James is the Deputy Executive Director and Chief Engineer for the Mississippi Department of Transportation.

Mr. Mark Bernhardt is the Director of Facility Inspection for Burgess & Niple, an engineering firm.

III. Brief overview

- Structural problems, both major and minor, plague a significant portion of bridges in the United States. According to the U.S. Department of Transportation's National Bridge Inventory, 73,764 bridges around the U.S. (12.4 percent of all bridges) were classified as “structurally deficient” in 2006, including the bridge that collapsed in Minnesota. The American Society of Civil Engineers (ASCE) in 2005 gave the Nation’s bridge infrastructure a “C” grade in its *Report Card for America’s Infrastructure* because of the large number of deficient bridges. However, the definition of structural deficiency is broad, and can cover everything from non-structural paving issues to serious flaws. State and local inspectors are responsible for determining which bridges need the most immediate attention.

- The challenge for policymakers at the state, local, and federal level is to determine which bridges are the highest priority for repairs given limited funding. ASCE estimates that repairing every deficient bridge across the nation would cost $9.4 billion per year for 20 years. Inspectors use a variety of methods to determine if a bridge has immediate need of repair, including visual inspection, sensors, and other non-destructive testing technologies. The existing methods are imperfect, however, and additional research is needed to develop methods that will provide better quality data on which bridges are in greatest need of immediate repair.

- The Federal Highway Administration, state highway administrations, and universities are sponsoring and carrying out research to improve bridge design, maintenance, and inspections. Current research covers a variety of fields, including materials, engineering design, technology development, and modeling. However, transferring successful technologies to end users such as state highway administration officials is challenging because of cost concerns and training issues for advanced technology.

- Additional research is needed to better understand the current and future demands on bridges. Traffic loads are significantly higher than when many of the country’s bridges were built, especially from truck traffic. FHWA is supporting research to design the “Bridge of the Future” with the goal of a century-long lifespan. This and similar projects should include projections for bridge usage throughout the intended lifespan to ensure that the bridge meets users’ needs.

IV. Issues and concerns

How are bridges currently tested for safety, and how effective are current testing methods and technologies? What technologies and techniques currently exist to improve bridges’ structural integrity? States are currently responsible for all bridge inspections, which must be carried out biennially under the National Bridge Inspection Standards (NBIS), which are enforced by FHWA. If a bridge is deemed potentially problematic, inspectors can increase the frequency of evaluations. Approximately twelve percent of bridges are inspected annually. Inspectors examine the bridge deck (primary travel surface), superstructure (which supports the deck), and substructure (which supports the superstructure). Each component is given a rating based on its current condition, ranging from excellent to failed or out of service. If the bridge gets less than 50 points in its overall rating, it can be classified as structurally deficient. For reference, before it collapsed, the I-35W bridge in Minneapolis received a score of 50.

Some technology is currently in use to aid inspectors in their assessments of bridges, but generally bridge inspectors depend on visual observations to determine if a bridge is deficient in any category. Bridge inspectors are trained through university programs and also must complete required courses through FHWA's National Highway Institute (NHI). These courses are also used to deliver information about new technologies emerging from the U.S. DOT.

What future research is needed in the overall field of bridge safety, and how can engineers insure that new technologies are an improvement on the current state of the art? Current bridge research covers three general fields: structural engineering, materials, and inspection technologies. Within these research areas, many different projects are carried out or funded by universities, state departments of transportation, and the Federal government. Some private research, especially in the area of technology design and development, is also carried out by industry. Research priorities are generally guided by end-user needs, and the transportation research community has a strong, centralized structure for sharing both research results and technology needs. The Transportation Research Board (TRB), part of the National Research Council (NRC), hosts an annual meeting and other smaller events to facilitate collaboration among researchers and end users that is a primary source of information on research priorities. Following the bridge collapse in Minnesota, TRB put a greater focus on the specific field of bridge safety and announced that its 2008 annual meeting would highlight the issue of aging infrastructure. AASHTO also convenes a bridge committee comprised of state highway officials who are able to discuss needs specific to their states.

FHWA is also working on their Bridge of the Future project, which aims to use innovative designs and materials to build a bridge that will have a lifespan of at least a century (compared to current 25 to 50 year lifespans). However, the new designs, materials, and technologies that are developed through these research projects will only be useful if they are able to meet the long term needs of users. Many current bridges—81,257 in 2007—are functionally obsolete because engineers were unable to accurately predict the types of traffic loads throughout the bridge's intended lifespan.

How can non-destructive testing of existing bridges and lessons from the Minnesota collapse be used to determine which bridges are the most susceptible to catastrophic failure? Currently, bridge inspectors rely primarily on visual inspections to determine whether bridges are in need of repair. While these inspectors go through rigorous training and take regular refresher courses to keep their skills up to date, there are obvious limits to inspections which cover only surface features of the bridges. New technologies are being introduced to help inspectors see into the structural elements of bridges so that they may better determine the overall strength and integrity. But there are barriers to adoption of these new technologies. Many are expensive and well outside the budget of state highway administrations. Others take highly technical training to operate effectively and are too difficult for busy bridge inspectors to learn to use. Some technologies also require near continuous monitoring or modeling to identify potential problems. Additional research is needed to develop technologies for non-destructive testing of bridges that are effective and efficient for bridge inspectors so that catastrophic failures can be predicted before they happen.

What technology transfer programs exist at FHWA and university transportation research centers, and how effective are those programs? In transportation fields, technology transfer is a special challenge because no solution works well for everyone. Differences in traffic loads, climate, size and shape, and other bridge characteristics mean that new engineering designs, materials, and technologies may work well for a bridge engineer in California but not in New York or Florida. Thus, technology transfer efforts must include both determining the customer's unique needs and transferring the appropriate technology. For the former, FHWA and the University Transportation Centers depend on organizations of end users, including TRB and AASHTO, to facilitate discussions of technology needs. The strong participation in these groups means that end users are making their needs known to the appropriate people, but technology adoption remains slow. FHWA programs to encourage the adoption of new technology include seminars and discussions at TRB events and courses offered at the National Highway Institute (NHI) to train engineers and inspectors in the use of new technology.

V. Background

The collapse of the I-35W bridge in Minnesota was, unfortunately, not the first of its kind. In 1967, a bridge from West Virginia to Ohio collapsed, killing dozens of people and spurring the Federal Highway Administration to standardize inspections of bridges to avoid future tragedies. The National Bridge Inspection System now uses a point system to help state inspectors and the Federal government determine which bridges are in greatest need of repair. On a 100 point scale, bridges that score less than 50 points are described as "structurally deficient." Some bridges are also classified as "functionally obsolete" meaning that they are unable to perform to the current necessary traffic capacity. These bridges limit the size of vehicles allowed to cross. Neither designation means that the bridge is in imminent danger of collapse. Points are awarded based on the condition of the substructure, superstructure, and surface; thus, a low scoring bridge may merely need repaving to bring it back from structural deficiency.

The sheer number of structurally deficient bridges around the country is cause for concern, though, because many do have underlying structural problems. In 2006, FHWA found that 73,764 bridges were structurally deficient, including the one that collapsed in Minnesota. There is not a centralized system that the Federal government uses to further classify structurally deficient bridges as suffering from dangerous structural (as opposed to cosmetic or less urgent) conditions. This makes it far more difficult to determine the true vulnerability of the bridges in the United States. The American Society of Civil Engineers (ASCE) has carried out their own assessment of the Nation's bridges, and found that the Nation's urban bridges, which carry much larger than average numbers of vehicles daily, are classified as structurally deficient at a much higher percentage than rural bridges, making the situation more dangerous than the number suggest on their own. ASCE has called for stronger investment in repairing infrastructure and long term research efforts. Repairs, however, are an enormous financial challenge. ASCE anticipates a total cost of $188 billion to repair all current structurally deficient bridges around the country.

While the issue of bridge structural problems is not new, changing patterns in the U.S. transportation sector have made fixing deficient bridges much more pressing. The Bureau of Transportation Statistics (BTS) found that the number of vehicles on roads and bridges has increased from 156 million to 235 million since 1980, and economic growth has spurred the long haul trucking industry to put more and heavier trucks on the road. These traffic loads are far higher than those originally anticipated by bridges' engineers, and may accelerate deterioration of already crumbling infrastructure.

Because it is financially and logistically unfeasible to repair all problematic bridges around the country in the short term, state highway administrations, bridge inspectors, and the public rely on the results of research and technology development to avoid catastrophic and deadly collapses. The research community has recognized bridges as a priority, and is putting available resources into both short and long term research to improve safety. However, funding for this research is extremely limited. FHWA has only approximately $22 million available for bridge related research, and must leverage research carried out by universities, states, and private industry to move forward.