Testimony of Mark V. Rosenker, Chairman
National Transportation Safety Board
Before the
U.S. House of Representatives
Committee on Transportation and Infrastructure
on
Structurally Deficient Bridges in the United States
September 5, 2007

Good morning, Chairman Oberstar, Ranking Member Mica, and Members of the Subcommittee. Thank you for allowing me the opportunity to present testimony on behalf of the National Transportation Safety Board. I am privileged to represent an agency that is dedicated to the safety of the traveling public.

Overview

As you know, the Safety Board is charged with investigating major transportation accidents, including highway accidents, determining their probable cause, and making recommendations to prevent similar accidents from happening again. Changes in highway or vehicle design, driver training, occupant protection, and regulatory oversight are frequently recommended.

Environment

Every day there are approximately 19,000 accidents on our Nation's highways, causing over 43,000 fatalities and 3 million injuries each year. The economic cost of these accidents is estimated to be about $231 billion a year, or over $800 for every person living in the United States. Without even attempting to calculate the emotional losses to the families of these victims, just the economic cost is a tremendous burden on our society.

Highway accident investigations present their own set of unique circumstances for the Board. As you know, the regulation and oversight of the aviation industry is solely a Federal function and receives oversight solely from the Federal Government through the Federal Aviation Administration and accident investigation by the NTSB.

In contrast, highway accident investigation and regulation is very decentralized. Virtually all of the 7 million highway accidents, which occur each year, are investigated at the state and local level by over 18,000 police departments, which employ some 800,000 staff. They investigate the majority of these accidents and provide an invaluable service to the safety community by documenting the circumstances of these accidents. Their hard, dedicated work greatly assists the Board in our investigations and the data they gather feeds into national

databases that assist in the decision-making of Federal regulator agencies such as the National Highway Traffic Safety Administration (NHTSA), the Federal Motor Carrier Safety Administration (FMCSA), the Federal Highway Administration (FHWA), and of course the Congress.

However, in this highly decentralized environment, the Safety Board provides a unique service. The Board is virtually the only organization that conducts comprehensive, thorough highway accident investigations that drill down into the root causes of accidents. These investigations are conducted in the same objective, comprehensive, and independent manner as the NTSB's aviation investigations and we often find root causes that are not readily apparent from the less exhaustive investigations conducted by state and local governments. Our investigations afford us the opportunity to make safety recommendations on highway safety issues that other organizations may be unaware of or may have overlooked.

Accident Selection Criteria

Because of the Board's small size, our effectiveness depends on our ability to select the most appropriate accidents and safety issues to investigate; issues and accidents that will lead to recommendations that will make a substantial contribution to the safety of the Nation's highway system. Given the volume of highway accidents, this is not an easy task, and it precludes any rote formula for selecting accidents.

Recognizing this, the Board's mandate in Chapter 11 of *United States Code* 49 is very broad. It charges the NTSB with investigating "highway accidents, including railroad grade crossing accidents, the Board selects in cooperation with a State." Given the millions of highway accidents that take place each year (19,000 per day), the Board must be highly selective in choosing those that will identify safety issues of national significance. Therefore, before we launch on an accident, we ask four basic questions:

- Is there high public interest?
- Are there potentially new issues, which others or we have not addressed?
- Can we make a difference?
- Do we have the resources?

Recent Safety Issues Uncovered

The Board's small highway staff delivers considerable value for the citizens of the United States by thoroughly investigating selective accidents and identifying new safety issues. Just in the past year, the Safety Board has addressed a number of important highway safety issues, including:

- highway median barriers,
- toll plaza designs,
- collision warning systems,
- heavy vehicle and passenger vehicle incompatibility,
- highway construction oversight,

- cell phone use by bus drivers,
- motorcoach occupant protection,
- inconsistencies in Federal accident databases,
- emergency egress from motorcoaches,
- fire resistance of motorcoach materials and designs,
- motorcoach wheel bearing maintenance,
- transportation of pressurized aluminum gas cylinders,
- emergency transportation of persons with special needs,
- Federal oversight of the motorcoach industry,
- epoxy use in highway construction,
- inspection of tunnels,
- tunnel design and construction, and
- motorcycle safety.

One of the reasons I am particularly proud to work for the Safety Board is that when tragedies do occur, the Board is able, by conducting thorough, objective, and transparent investigations, to restore the public's confidence in the safety of our transportation systems. Following its investigation, the Safety Board makes focused, appropriate recommendations to fix safety deficiencies so similar, future tragedies can be prevented.

Boston "Big Dig" Tunnel Accident

For example, when the ceiling panels collapsed in one of the Big Dig tunnels in Boston last year, Congress immediately turned to the Safety Board to investigate this tragedy because of our reputation for thorough, independent accident investigations; and our independence is the key. Any number of other organizations could have conducted an investigation, and many still are, but for such a high-profile, high-cost, high-visibility project as the Big Dig, with all the problems that it has had, the Congress recognized that the public needed an independent body to lead this investigation.

As you may recall, the accident occurred on July 10, 2006, when a section of the ceiling panels of the D Street portal of the I-90 connector tunnel became detached from the tunnel and fell onto the roof of a sedan, killing one of the two occupants. A total of about 26 tons of concrete and suspension hardware fell onto the vehicle.

The 30 NTSB staff members who worked on this investigation (almost 10 percent of the agency) examined the role of 24 organizations (15 of which were potentially associated with the cause), and sifted through 400,000 documents to complete the investigation.

What resulted from this investigation radically changed the thinking in the highway construction industry about the long-term structural properties of epoxy in overhead applications as they relate to epoxy creep. It is now extremely unlikely that any design or construction company will ever use epoxy the way it was used in Boston without a thorough understanding and testing of the product.

Most importantly, once the public became aware that the Safety Board was conducting this investigation, they were reassured that the ultimate cause of the ceiling collapse would be found and proposed solutions would be made. So when we have a bridge collapse in Minneapolis, the public demands answers, and it turns to the Safety Board for those answers to restore their confidence in our highway bridges.

What we bring to the table

Therefore, it is important to understand what the Board brings to the table. First, we bring accident investigation expertise and methodology that has a worldwide reputation for finding the root cause of transportation accidents. Second, our willingness to allow parties to participate in our investigations expands our resources up to 10 fold and builds on our expertise by allowing us to utilize some of the world's experts in transportation safety. The collective knowledge of all the participants in our investigations ensures that all options are examined, and no stone goes unturned. Third, the openness of our investigations reassures the public that they will eventually have access to all the facts we uncover and that we are confident enough in our analysis that we make the entire process available for public scrutiny. Finally, our independence ensures that an unbiased judgment will be made by an organization that does not have a vested interest in the transportation mode being investigated. If we do our job right, using all these tools, the public will be reassured that the problems that resulted in, or caused an accident, will be ultimately identified and remedied. That is the value of the Board in this endeavor.

Historical Perspective:
(Bridge Accident Investigations and the National Bridge Inspection Program)

Discussions of the Nation's highway infrastructure and the safety of older bridges often begins with the 1967 Safety Board investigation of the collapse of the 39-year-old Silver Bridge in Point Pleasant, West Virginia, in which 46 people were killed. This is because, as a direct result of the Board's recommendations, the FHWA established national inspection standards for locating, inspecting, evaluating, and correcting bridge deficiencies to ensure that bridges are safe. Shortly thereafter Congress established the Highway Bridge Replacement and Rehabilitation program and the Discretionary Bridge Program—the precursors to the bridge inspection programs of today.

In fact, the majority of the improvements that have been made to the Nation's bridge inspection programs, stem directly from NTSB investigations and recommendations of significant bridge collapses. For example:

- After the 1987 bridge collapse into the Schoharie Creek in New York, in which 10 people were killed, the FHWA established a scour inspection program.

- After the 1983 I-95 bridge collapse into the Mianus River in Greenwich, Connecticut in which 3 people died, the FHWA established a fracture critical inspection program.

- After the 1985 Chickasawbougue Bridge collapse in Mobile, Alabama, the FHWA established an underwater bridge inspection program.

These were all direct outcomes of the Safety Board's recommendations.

Like the establishment of the National Bridge Inspection Program, the Board is now in the forefront of the safety of the Nation's tunnels. As a result of our investigation into the Boston Big Dig ceiling collapse, the Board found that there were no national inspection standards or procedures for tunnels. Therefore, the Board recommended to the FHWA to:

- Seek legislative authority to establish a mandatory tunnel inspection program similar the National Bridge Inspection Program; and

- Once provided with the authority, then implement a tunnel inspection program that will identify critical inspection elements and specify an appropriate inspection frequency.

We hope that this program comes to fruition.

Update/Status of Minneapolis Investigation

I will now turn to the issue at hand--the August 1 collapse of the I-35W Bridge over the Mississippi River in Minneapolis, Minnesota. Approximately 1,000 feet of the 1,900-foot-long truss–built bridge collapsed, with approximately 456 feet of the center span falling about 108 feet into the 15-foot-deep river. There were a total of 110 vehicles on the portion of the bridge that collapsed, and about 17 vehicles fell into the water. At the time of the accident, roadway construction was being conducted on the center span, and four of the bridge's eight lanes were closed for re-paving. The bridge had last been inspected by the Minnesota Department of Transportation (MnDOT) on June 15, 2006.

Let me give you a little insight into our investigative process and the status of our ongoing investigation.

The Safety Board launched a team of 19 investigators and support staff, roughly 3 times the usual number for a major launch. The investigators included engineers and experts from many disciplines. Eventually all of the Board's highway engineers and all of our metallurgical and materials lab specialists, including the Board's senior metallurgist, would become involved in the investigation along with several specialists in survival, human, and vehicle factors, and members of our disaster assistance program, who work with the victims' families. The on-scene recovery effort would eventually require round-the-clock monitoring of the recovery operations as many of these investigators pulled duty to monitor the 24-hour work to remove and recovery the bridge span and to analyze and document the critical bridge components. It would take 20 days to complete victim recovery.

In addition, as is our practice, parties to the Board's investigation were established, including the FHWA, the Minnesota Department of Transportation, the Minnesota State Patrol, the Minneapolis Police Department, the Hennepin County Sheriff's Department, and Progressive Contractors, Inc. These parties participate in collecting evidence and facts, under the leadership of Board employees. They do not, however, participate in the analysis of those facts, or the

development of conclusions or recommendations made by the Safety Board. Each Group is headed and managed by an NTSB investigator and an Investigator-In-Charge (or IIC) manages the Groups.

The following Groups were created, but additional groups can be established anytime:

- Highway Factors and Bridge Construction Group
- Bridge Design Group
- Witness Group
- Survival Factors/Emergency Response Group
- Scene Mapping and Evidence Collection Group
- Video and Photogrammetry Analysis Group
- Structural Investigation Group
- Computer Modeling Group
- Transportation Disaster Assistance Group

I will briefly describe the status of each of these groups' investigation.

Highway Factors and Bridge Construction Group

The Highway Factors and Bridge Construction Group is collecting information to evaluate the effects, if any, of the bridge construction and rehabilitation that was ongoing at the time of the accident. The Board has already interviewed 25 construction workers and truck drivers who were involved in delivering and/or using the construction material on the bridge. The Group is also reviewing the daily construction records and diaries to determine the location of construction equipment and raw materials on the bridge at the time of the collapse, and to verify the weights of those vehicles and materials. The Board has obtained core samples of the bridge deck material to get a better picture of the deck thickness to help make an assessment about the amount of concrete on the bridge at the time of the accident and its weight. The Board has also obtained a photograph of the bridge and the construction staging area that was taken by a passenger on an airplane that was departing from Minneapolis on the afternoon of the collapse. In addition, information is being gathered on the permitted loads that have traveled across the bridge in the past 12 months. The Highway Group will develop a historical list of the various construction projects and modifications that have been performed on the bridge since its original construction.

The weights of the various construction materials that were delivered to the work site between 11:00 a.m. and 2:30 p.m. on August 1 are currently estimated to be about 383,000

pounds. The combined weight of the loads and construction vehicles was about 575,000 pounds, or 287 tons.

Bridge Design Group

The Bridge Design Group will look at a number of factors that concern the bridge design, other deck truss bridges of similar design, and maintenance and inspection practices. Safety Board investigators have received records from the bridge designer and will assess the original design calculations.

The Bridge Design Group will also conduct a detailed analysis of the adequacy of the National Bridge Inspection Program as it relates to identifying any preexisting problems with the Minneapolis I-35 bridge. Components of this program include the national bridge inspection standards (NBIS) and the national bridge inventory (NBI), which currently rate bridges using a bridge sufficiency rating system to identify structurally deficient and functionally obsolete bridges. The adequacy of these programs to identify any problems found with this bridge will be examined. The I-35 bridge was considered structurally deficient because of a relatively low rating of its superstructure.

Witness Group

The Witness Group will accomplish a number of tasks, including the collection of eyewitness descriptions, pictures, videos, or other evidence associated with the collapse. For example, investigators interviewed the crew of a dinner cruise ship that was near the bridge at the time of the collapse. This work is being done in cooperation with the Minneapolis Police Department and other agencies. The Witness Group will also be interviewing witnesses and vehicle occupants and evaluating these statements to document the motion of the bridge during the collapse sequence and the position of vehicles and witnesses prior to the collapse. So far the Board has contacted or interviewed 314 witnesses and received more than 180 calls to the witness hotline.

Survival Factors/Emergency Response Group

The Survival Factors/Emergency Response Group will document the post-collapse positions of vehicles on the bridge, the types of injuries received by vehicle occupants and construction workers, and the effectiveness of the emergency response to the accident. So far, the Group has documented 109 of the 110 vehicles involved in the collapse. One vehicle remains under debris. A total of 185 people were on the bridge at the time of the collapse, 17 of whom were construction workers. Of the 185, 133 were injured, and 13 were killed. The initial response to the tragedy involved more than 50 agencies, with the Minneapolis Police arriving within 3 minutes, the Minneapolis Fire Department responding within 4 minutes, and search and rescue operations by the Hennepin County Sheriff's Department beginning within 7 minutes. Ten hospitals accepted victims from the accident.

Scene Mapping and Evidence Collection Group

The participants in the Board's Scene Mapping and Evidence Collection Group are continuing to collect evidence and document the final rest positions of the vehicles on the bridge and the exact positions of each of the bridge components, utilizing a number of tools and collection methods. The FBI, MnDOT, and local police departments are providing assistance. The Mapping Group's diagrams and computerized data will provide detailed measurements of the configuration of the collapsed bridge structure for further evaluation in conjunction with the finite element analysis being performed under the direction of our Computer Modeling Group. Eventually, 3-D views will also be available for illustrative and evaluation purposes.

Video and Photogrammetry Analysis Group

The Video and Photogrammetry Analysis Group has obtained the original security camera video equipment and footage provided by the Army Corps of Engineers that shows a portion of the bridge collapsing, which you have likely seen on TV and the Internet. This Group is reviewing the video and all the recording components in our laboratory. We are also engaged in a detailed review and analysis of all other photographic and video imagery that was created prior to and following the accident, to fully document the sequence of events. Tools used early on in this effort included a high-resolution gyro-stabilized camera mounted on a state police helicopter used to photograph the bridge's superstructure.

Structural Investigation Group

The Structural Investigation Group has members from FHWA and MnDOT and is collecting and documenting the structural components of the bridge and working to determine the initiating location and failure sequencing of the structure. This has involved conducting inspections of the accessible areas of the bridge since the first day of the investigation. This work continues slowly as the tedious effort to remove damaged portions of the bridge must be conducted without destroying any critical evidence.

The Structural Group continues to examine gusset plates at particular locations and have observed damage that warrants further investigation (gusset plates are steel plates that tie steel beams together). Safety Board investigators are verifying the loads and stresses on the gusset plates at these and other locations, as well as assessing the materials used in the construction of the gusset plates to help determine whether these locations represent primary or secondary failure points.

The Structural Group has completed its initial documentation on all observable portions of the structure and therefore, the south and north approach spans have been released to MnDOT for removal. Additional structural areas of the truss portion of the bridge are being examined as they are removed from the water or uncovered on land. A layout area in "Bohemian Flats Park," not far from the accident site, has been established to store portions of the bridge for further analysis. Selected portions of the main trusses and floor trusses are being laid out at the Park. Once layouts are complete, another overall examination will be conducted.

Some components have been chosen for more detailed laboratory examination and materials characterization. Portions of those components may be shipped to the Board's Laboratory in Washington if further examination and analysis is deemed necessary. This will begin after layouts have been examined.

The sequencing study that is planned will take factual observations regarding fracture locations and directions, deformation patterns, damage marks, and the final resting positions (compared to the original location), and will attempt to generate an overall sequence of separation, leading back to the earliest identifiable fracture area or areas. Right now, it is unknown how far this process will take us, because we have not recovered all of the structure. Nevertheless, we are hopeful that it will at least give us options on which our computer modeling effort to may concentrate.

So far, the Safety Board has only recovered about one half of the bridge structure, the remaining half still being in the water.

Computer Modeling Group

The Computer Modeling Group is working with the Federal Highway Administration and MnDOT to conduct a structural analysis of the bridge, using computational Finite Element Analysis methods. Within days of the collapse, development of the computer model, based upon the original design drawings, began at the FHWA's Turner-Fairbank Highway Research Center in McLean, Virginia.

The Group is currently validating a global finite element model of the bridge to explore loading and failure scenarios. The finite element model of the bridge is being revised based on the measured deck thickness from core sections and physical examination of the bridge structure. All structural elements have been incorporated into the model; however, some aspects of stiffness, weight, and connections between elements are being modified to match the condition of the bridge on the day of the accident. Strain gage data from a 2001 study by the University of Minnesota is being used to ensure that the model accurately mimics the structure. In addition to information from the wreckage, the modeling effort will require input data from tests of the material properties of the critical structural elements. The testing will be performed by FHWA under the Board's supervision, once the wreckage has been assessed on-scene and then sent to Turner-Fairbank for laboratory examination.

The loads calculated in the global model will be used in more detailed models of specific structural members. The choice of the structural members studied with the more detailed modeling will be guided by the findings in the wreckage. The goal of the detailed modeling is to identify specific failure mechanisms that participated in the collapse.

Historical records concerning the bridge design and any engineering analysis of the components have been collected from MnDOT and the original bridge designer. Calculations include the main truss members, but no documents showing the calculations regarding riveted gusset plate connections have been found so far. The Group will continue to review all available design calculations.

Transportation Disaster Assistance Group

The Board's Transportation Disaster Assistance Group worked on scene with 74 other local, state, and Federal agencies that assisted in the disaster. The Board received outstanding cooperation from all these organizations, and in particular, the Minneapolis Police Department and the Minnesota State Patrol were extremely helpful. The Board conducted briefings for between 40 and 50 family members each evening concerning the progress of the NTSB's investigation. These briefings were held at the on-scene Family Assistance Center that was operated by the Minneapolis Police Department. Briefings began the 2nd day after the disaster and continued for the next 9 days. The Minneapolis Police Department Chaplains then worked directly with families at their homes until victim recovery operations were completed. As an example of the magnitude of the assistance provided, the Red Cross served 33,000 meals in the first 10 days of the disaster.

Summary

The Board is still in the initial stages of its investigation and, as you can see, there is still much work to be done. As new and significant developments occur, we will be sure to keep the committee and the public informed. Today, there are still NTSB investigators on scene in Minneapolis, and they are likely to be there until November or however long it takes for the bridge components to be fully recovered.

Thank you for the opportunity to speak today and I would be delighted to respond to any questions you may have.