Testimony of

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

Mr. Chairman, Honorable members of the Science and Technology Committee, good morning.

My name is Mark Bernhardt and I am the Director of Facility Inspection for Burgess & Niple, Inc. in Columbus, Ohio. I have been working in the bridge inspection field for over 10 years and in that time I have managed, reviewed, or performed more than 3,000 bridge inspections and 160 load ratings.

Burgess & Niple is also a member of ACEC, the American Council of Engineering Companies, the business association of America's engineering industry representing over 5,500 member firms across the country. On behalf of ACEC and the industry, we appreciate the opportunity to testify before you today to discuss the research and technology that contributes to bridge safety.

Bridge deterioration is a significant problem facing transportation agencies nationwide. This is evidenced by the more than 73,000 structurally deficient bridges currently listed in the National Bridge Inventory (NBI). In order for federal, state, and local agencies to make sound decisions regarding bridge maintenance, rehabilitation, and replacement programs, they require comprehensive information on bridge conditions. Many factors control the validity of the data being supplied to the decision makers in transportation agencies. These factors are as varied as inspector training and experience; effectiveness of bridge management systems; inspection methods; and available funding. All of these factors play a role in ensuring bridge safety. In today's testimony, I will focus my comments on just one of these areas – inspection methods. Specifically, I will outline some common techniques and technologies employed during bridge inspection operations, the emerging field of Structure Health Monitoring, and the effectiveness of technology transfer programs.

BRIDGE INSPECTION TECHNIQUES

Bridge inspections in the U.S. are generally visual, thus qualitative in nature, and follow the requirements outlined in the National Bridge Inspection Standards. Bridge inspections are performed to determine if any immediate hazards exist that would warrant reducing allowable loads on a structure or closing it entirely; to ascertain the extent of deficiencies or structural damage resulting from deterioration or other causes; and to enable bridge maintenance, repair, or replacement to be programmed effectively through early detection of deficiencies.

The primary tool employed by bridge inspectors today is the eyes. A comprehensive study of the reliability of visual inspection was performed by the FHWA's Non-Destructive Evaluation Center in 2001. This study suggested that visual-only inspections provide data that is often highly variable and influenced by many factors such as the inspector's comfort level with working at height, structure accessibility, and duration of inspection. With regard to localized defects in superstructure members, the study found that less than 8% of the inspectors successfully located weld cracks and other implanted defects in test bridges. It is the general consensus within the engineering community that visual inspection practices must be supported by rigorous training, certification and quality assurance programs, and supplemented with testing techniques to ensure reliable results.

Many common and proven non-destructive and destructive testing techniques are available to the inspector to supplement visual observations and provide more useful quantitative data. Additionally, the emerging field of Structure Health Monitoring holds much promise for real-time evaluation of structures and objective evaluation of bridge conditions. Providing more quantitative data to bridge program managers enables them to more effectively allocate bridge rehabilitation dollars. One current challenge with these tests, however, is how to best integrate the results into existing Bridge Management Systems.

The primary nondestructive evaluation techniques utilized during the inspection of steel bridges include magnetic particle, dye penetrant, and ultrasonics. These tests are relatively low cost, and proven protocols have been developed for their use and the interpretation of results. For concrete bridge decks, very simple procedures such as dragging a chain across a bridge deck can be a very good indication of hidden deficiencies. Its modern counterpart, Ground Penetrating Radar, can do the same thing, only much more objectively and with repeatability. Electrical potential can be measured to assess corrosion of embedded reinforcing steel, samples of concrete can be extracted for laboratory testing, and Impact Echo tests can be used to locate voids in post-tensioning ducts. The Bridge Inspector's Reference Manual, which forms the basis of bridge inspector training programs nationwide, details these test methods as well as dozens of other effective methods.

LIMITATIONS OF CURRENT PRACTICES

What these tests all have in common, as well as the federally mandated NBI inspections, is that they are often used to record conditions only at a single point in time. They are a mere a snapshot of bridge conditions. While this is generally adequate for relatively low risk structures, structurally deficient or complex structures that pose a greater risk to the traveling public require more. This is where Structure Health Monitoring holds the most promise. Structure Health Monitoring involves the installation of various sensors and monitors onto bridge components that allow for remote collection and observation of data at anytime. These can include strain gages, weigh-in-motion systems, fiber optics, cameras, corrosion sensors, and acoustic emission equipment, all tied to data servers and digitally accessible in real time. While a number of successful structure monitoring programs have been implemented, the technology is still emerging. Funding for research and “pilot projects” in this area should continue to be a priority. Bridge engineers can be most effective by providing the decision makers in transportation agencies with objective, data driven recommendations. The structural condition data, combined with operational “risk-based” factors such as traffic counts, can be used to determine optimum prioritization of bridge repairs.

Underlying all of this, however, is the fact that simply collecting more data and providing more frequent inspections will not improve overall bridge safety. The engineering and scientific community can help to improve the relevance of the data by further researching advanced testing techniques. Additional funding for bridge repair and replacement is required to adequately keep pace with bridge program needs.

FHWA LONG TERM BRIDGE PERFORMANCE PROGRAM

Presently, the FHWA is in the process of rolling out its Long Term Bridge Performance Program. This proposed 20-year program will provide the funding and opportunity to develop standard protocols for the myriad of nondestructive testing methods, sensors, and monitoring systems available. The engineering community requires more knowledge in the areas of life cycle costs, deterioration models and mechanisms, and validation of the effectiveness of repair and rehabilitation strategies to improve the practice of bridge management. Another goal of this long term program is to provide such data. I would encourage the members of congress to continue funding this essential program when its budget comes up for renewal.

FEDERAL TECHNOLOGY TRANSFER

Professional Engineers benefit greatly from the results of research and technology programs funded by the Federal government. The traveling public is the greatest beneficiary, however. Lessons learned and conclusions reached during NCHRP and FHWA research projects are effectively disseminated to practicing bridge engineers. They are immediately incorporated into improved design, evaluation and analysis methods.

In the weeks following the Minnesota I-35 bridge collapse, Burgess & Niple was asked by a number of state transportation agencies to assist with the inspection of steel deck truss bridges. This work was performed in response to FHWA Technical Advisory 5140.27 – Immediate Inspection of Deck Truss Bridges Containing Fracture Critical Members. In general, the inspections were carried out in the same manner as those completed prior to the I-35 collapse. Some additional focus was placed on the gusset plate connections between members due to speculation that this was an area of concern on the I-35 bridge.

The investigation into the I-35 bridge collapse is still ongoing. It will likely be some time before the investigating engineers reach a definitive conclusion as to the precise cause of the collapse. Even if the cause of the collapse is found to be unrelated to bridge inspection practices, it is my hope that the dialog that has resulted from this tragic event will lead to improvements in the field of bridge inspection and result in a safer and improved infrastructure system. A better understanding of bridge conditions through expanded use of testing and Structure Health Monitoring can help to improve both the allocation of bridge repair funds and bridge safety.

Thank you Mr. Chairman and I am happy to answer any questions you or the committee members may have.