



NONDESTRUCTIVE EVALUATION CENTER LABORATORY FACT SHEET

Research that is Essential, Indispensable, and Connected to Our Customers.

PURPOSE

The Nondestructive Evaluation (NDE) Center was established by the Federal Highway Administration (FHWA) in 1998 in an effort to centralize and better coordinate research related to nondestructive testing. Since its establishment, the center has acted as a resource to the FHWA and States for information and expertise on nondestructive testing tools and technologies. Researchers at the center develop and evaluate NDE technologies that can be used to assess the condition of highway bridges. This assessment includes evaluating current technologies and developing new tools that will advance the practice of bridge inspection.

A goal for the NDE Center is to provide advanced NDE research within the context of an integrated view of highway facilities that include bridges, pavements, and other structures such as culverts, retaining walls, and tunnels. The key aspect of this vision is to augment the research focus to not only the internal elements of the highway bridge but also to global structural health monitoring (SHM) so that the bridge is viewed as a component in the overall highway system.

DESCRIPTION

The NDE Center is staffed with a multidisciplinary team of experts working on tools and techniques to assess the condition of in-service highway bridges and bridges under construction. Laboratory researchers

work closely with State transportation departments throughout the United States to identify and solve inspection challenges.

Areas of research at the laboratory include ultrasonic testing methods for steel and concrete, ground penetrating radar (GPR), passive and active infrared thermography, fatigue crack detection and assessment methods, magnetic flux leakage, radiography, noninvasive measurement of girder deflections, and electromagnetic NDE techniques. Researchers also develop nonlinear finite element models of bridge structures and components using parallel supercomputers as an aid to understanding optimal application of NDE technologies.

MAJOR COMPONENTS

The center is comprised of a laboratory that is equipped with state-of-the-art instruments to help researchers develop and test NDE tools. The laboratory also has access to shared resources with the Turner-Fairbank Highway Research Center Structures Laboratory, including a structural load floor and mechanical testing equipment. In addition to laboratory resources, the center has local in-service test bridges, and it develops instrumentation and devices.

The laboratory is equipped with a number of commercial NDE tools as well as specialized instrumentation used to assess bridge structures. Some of the laboratory and field equipment include the following:

- Conventional and phased array ultrasonic testing systems.
- Eddy current array systems.
- Fatigue crack detection and monitoring systems.
- Infrared camera systems.
- GPR systems.
- A multisensor bridge deck inspection system.
- Ultrasonic array and impact echo systems for concrete imaging.
- An interferometric microwave radar system.
- Acoustic emission systems.

Additional capabilities of the laboratory include the following:

- General purpose data acquisition systems for laboratory and field testing.
- Vehicles equipped with instrumentation necessary for field testing.
- Parallel processor computer systems with the capability to perform finite element modeling.

Specimens and outdoor testing facilities at the laboratory include the following:

- A bridge deck test pit for evaluating vehicle-mounted deck inspection methods.
- Full size segmental concrete specimens.

The Turner-Fairbank Highway Research Center (TFHRC) has more than 24 laboratories for research in the following areas: safety; operations, including intelligent transportation systems; materials technology; pavements; structures; and human centered systems. The expertise of TFHRC scientists and engineers

covers more than 20 transportation-related disciplines. These laboratories are a vital resource for advancing this body of knowledge created and nurtured by our researchers. The Federal Highway Administration's Office of Research, Development, and Technology operates and manages TFHRC to conduct

innovative research to provide solutions to transportation problems both nationwide and internationally. TFHRC is located in McLean, VA. Information on TFHRC is available on the Web at www.tfhrc.gov.

- Local test bridges that are open to traffic and available for testing.
- Bridge component specimens with known defects.

ACCOMPLISHMENTS

Working with State transportation departments, the NDE Center has developed many methods and tools to assess the condition of highway bridges. For example, the center recently completed phase I of a research program to assess technologies to monitor and detect fatigue cracks in steel highway bridges.

The laboratory has also developed a hands-on training course to expose State transportation department personnel to commercially available NDE instruments. Known as the Bridge Inspector NDE Showcase (BINS), the course seeks to familiarize bridge inspectors with various NDE tools. The FHWA NDE Web Manual supplements this training with a fundamental understanding of NDE tools. As a result of BINS and the NDE Web Manual, updates will likely be provided to the National Highway Institute's (NHI) *Bridge Inspector's Reference Manual* and other inspection-related courses offered by the NHI.⁽¹⁾

CURRENT RESEARCH

The laboratory is active in a number of areas related to the inspection of steel bridges including the following:

- **Fatigue crack detection:** The center is conducting a study to assess fatigue crack detection and assessment technologies to aid in the inspection of steel bridges. The study includes laboratory and field evaluation of advanced NDE methods for crack detection and monitoring.
- **Gusset plate inspection:** Subsequent to the collapse of the I-35W bridge in Minneapolis, MN, in 2007, the inspection of gusset plate connections has become a priority. The NDE Center is working on a project to determine the capabilities of advanced inspection techniques for areas that are difficult to examine in order to aid inspectors in determining the condition of typical gusset plate connections.

The laboratory is also performing the following research on concrete bridge inspection technologies to advance current critical inspection practices:

- **Bridge deck corrosion assessment:** The center is researching the use of multiple techniques to assess corrosion in concrete bridge decks. This includes active thermography using induction heating, GPR, impact echo, and other methods.
- **Prestressed strand assessment:** The center is also researching better methods to assess the condition of ducted and unducted prestressing embedded in concrete bridge components. The aging population of prestressed concrete girders and recent problems encountered by a number of State transportation departments has made this inspection problem a national priority.

The laboratory is also conducting the following research in areas of load rating and SHM:

- **Rapid load rating:** The center is assessing methods to load rate bridges more rapidly and effectively and to globally assess bridge structures. This includes SHM using computer modeling techniques.

Finally, the laboratory is performing the following technology transfer and outreach efforts related to NDE technology:

- **NDE Web Manual:** The NDE Web Manual is a comprehensive Web-based collection of NDE techniques and methods prepared by NDE to aid State transportation department personnel in the selection and proper application of NDE systems.
- **BINS:** BINS is a hands-on training course designed to expose State transportation department personnel to a selected group of commercially available NDE technologies, which include coursework material, video presentations to illustrate equipment operation, and hands-on equipment demonstrations.

PARTNERSHIPS

The NDE Center has partnerships and cooperative agreements with several organizations as follows:

- State transportation departments, other FHWA offices, and Federal agencies are all

partnered with the NDE Center. All 50 States have participated in laboratory activities since it opened in 1998.

- NDE experts from various institutions and organizations are partnered to compile the comprehensive NDE Web Manual on NDE techniques and methods related to the inspection of transportation-related structures.
- NHI develops new NDE-related course material for the BINS course.
- Transportation pooled fund studies with State transportation departments are partnered to conduct NDE research. This includes a project lead by the West Virginia Department of Transportation to find methods to rapidly load test bridges as well as a project lead by the New York State Department of Transportation to develop procedures and practices for use of NDE methods.
- Various universities around the country were selected for partnership including the University of Virginia, Drexel University, the University of Vermont, and Rutgers University.
- The National Research Council is partnered with the NDE Center, including a research program that provides a research fellow from the Federal Institute for Materials Research and Testing (BAM) in Germany.
- International organizations such as BAM in Germany and Laboratoire Central des Ponts et Chaussées in France are partnered. The NDE Center and BAM have worked to deploy an NDE compendium of technologies and applications to aid in the dissemination of information on NDE techniques.

REFERENCE

1. Federal Highway Administration. (2004). *FHWA Bridge Inspector's Reference Manual*, Report No. FHWA-NHI 03-001,002,004, Department of Transportation, Washington, DC.

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