



STRUCTURES LABORATORY FACT SHEET

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

When traveling over bridges and highway ramps, virtually all motorists take for granted that these structures will hold. By applying the reliable research done in the Structures Laboratory, State and local highway agencies justify and maintain that confidence.

PURPOSE

The primary mission of the Structures Laboratory is to conduct experimental studies to determine the behavior of bridge components and full-size bridges. Data from these studies are used to improve the national bridge design specifications and to improve the safety, reliability, and cost-effectiveness of bridge construction in the United States. The development and evaluation of advanced high-performance materials and systems—e.g., high-performance steels, high-performance concrete, fiber-reinforced polymer composites, and adhesives—is a major focus of the current research program. The laboratory also investigates structural failures that occur in service to determine the cause of failure and to develop practices and procedures to prevent similar failures anywhere in the Nation.

DESCRIPTION

The Structures Laboratory is a world-class facility optimized for large-scale, indoor testing of bridge structures and components. The main laboratory is uniquely designed to erect full-scale bridges indoors and to test them using the latest technology. Everything from small specimens to full-size bridges can be subjected to simulated truck loads to evaluate strength and

performance. This laboratory maintains the capability to evaluate the strength and mechanical properties of structural materials and to instrument and perform field evaluations of in-service bridge structures. These characteristics and the following capabilities make this lab uniquely suited for large, multi-year efforts involving pool funding from States and Industry:

- Fundamental research into the strength and safety of bridge structures and components.
- Fundamental research into the fatigue-resistance of structures under truck loading.
- Applied research to assess the suitability for service of various structural components and systems.
- Field evaluation of in-service structures.
- Forensic evaluation service of structural failures.

MAJOR COMPONENTS

- 181-foot by 51-foot indoor “strong floor” with a grid of 573 hold-down locations.
- 40-foot by 12-foot indoor strong floor (shared with the Nondestructive Evaluation Validation Center).
- Two universal load frames (1,000,000-lb static load capacity, 440,000-lb dynamic load capacity).
- Indoor cranes, forklifts, and rigging equipment (20-ton capacity).
- Numerous static load actuators (10,000-lb to 1,000,000-lb capacity).
- Numerous dynamic load actuators (10,000-lb to 220,000-lb capacity).
- Numerous instruments to measure load, dis-

placement, rotation, and strain in structures.

- State-of-the-art computerized data acquisition (1,500-channel capacity).
- Laser displacement measuring system to perform 3-D measurements of structural response.
- Structural material-testing room with three mechanical testing and simulation (MTS) servo-hydraulic load frames, Charpy Vee-Notch (CVN) tester, two hardness testers, and a drop tower.
- Metallurgical testing room, including microscopes and metallurgical testing equipment.
- Portable telemetric data acquisition systems for field instrumentation of structures.
- Computers, UNIX workstations, and software to perform advanced, non-linear finite element modeling of structural behavior.

ACCOMPLISHMENTS

Recent Activities

- Helped develop the American Association of State Highway and Transportation Officials (AASHTO) Autostress design procedure to reduce the cost of steel bridges.
- Developed new equations for the safe design of prestressed concrete bridge girders and slabs.
- Helped develop new fatigue-design procedures in the AASHTO specifications to ensure adequate service life of steel bridges.
- Verified the load-carrying capacity of a new lightweight aluminum bridge deck system.
- Demonstrated the feasibility of using fiber-reinforced plastics (FRP) to repair damaged concrete bridges.

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 Research, Development, and Technology

Service Business Unit operates and manages TFHRC to conduct innovative research to provide solutions to transportation problems both nationwide and internationally. TFHRC is located in McLean, Virginia. Information on TFHRC is available on the Web at www.tfbr.gov.

- Evaluated the performance of FRP concrete reinforcement systems.
- Helped develop and test a new lightweight FRP bridge deck system.
- Assisted States and FHWA Divisions with field evaluation of special problems in structures—e.g., Hoan Bridge fracture failure (WI), I-664 in Hampton Roads (VA), Case Bridge (DC), Woodrow Wilson Bridge (VA, MD, DC).
- Assisted the National Transportation Safety Board investigation of the collapse of the Fowler Bridge (NY).

Current Activities

- Developing improved specifications for design and analysis of horizontally curved steel bridge structures. The Structures Laboratory is providing the experimental data and analyses to support AASHTO's development of the new Load and Resistance Factor Design (LRFD) Curved Girder Specification.
- Evaluating ultra-high-performance concrete bridge girders. These are the first full-scale tests of this new super-strength material to study how it can improve bridge performance.
- Developing retrofit methodology to protect

structures from the type of fracture failure identified in the Hoan Bridge.

- Developing design rules that allow full use of high-performance steels and improve the efficiency of steel bridge design.
- Developing fatigue specifications to allow the use of powder-actuated fasteners to attach concrete forms to steel bridge girders.

Future Activities

- Develop an experimental basis for design equations and rules to optimize the efficiency and safety of curved box-girder bridges.
- Investigate the performance of lightweight FRP deck systems on steel bridge superstructures.

PARTNERS AND CUSTOMERS

The Structures Laboratory continually partners with other research institutions, AASHTO, individual States, and industry organizations to reduce costs and promote implementation of research results.

- The curved girder bridge study is a major partnership involving AASHTO (a 26-State pooled fund effort), the National Cooperative Highway Research Program (parallel NCHRP proj-

ect 12-52 to develop a new bridge code), the American Iron and Steel Institute, and the National Steel Bridge Alliance.

- The high-performance steel (HPS) fatigue and fracture study is being performed in partnership with the U.S. Navy and the American Iron and Steel Institute and is directly supporting FHWA's Innovative Bridge Research and Construction Program.

Past partners over the last 10 years include:

- Industry organizations (American Concrete Institute, American Iron and Steel Institute, American Institute for Steel Bridge Construction, and the National Steel Bridge Alliance).
- Individual companies (Florida Wire & Cable, Reynolds Metals Corp., Invocon Electronics).
- Research institutions (Georgia Tech, Virginia Transportation Research Council, University of Maryland, Lehigh University, Catholic University, California State University-Long Beach, and the University of Nebraska-Lincoln).
- State departments of transportation (Wisconsin, Nebraska, New York, Tennessee, and Virginia).

