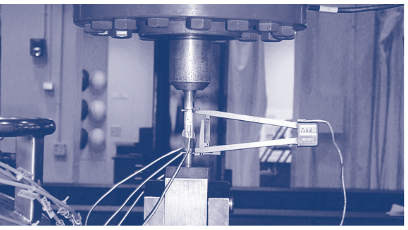

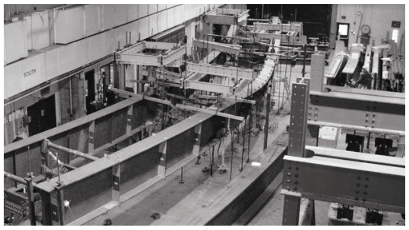

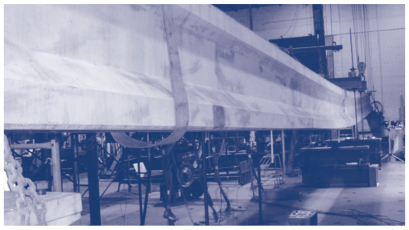

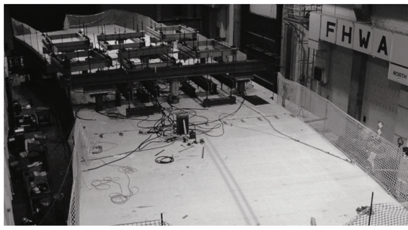

STRUCTURES LABORATORY FACT SHEET

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

The approximately 600,000 bridges, including bridges on the National Highway System, as well as bridges maintained and operated by various state and local entities are essential of our Nation's mobility. The Structures Laboratory (Lab) at the Turner-Fairbank Highway Research Center is a unique facility of the Federal Highway Administration (FHWA) that specializes in developing and testing innovative bridge designs, materials, and construction processes that promise more efficient and structures in the Nation's highway system.

PURPOSE

The purpose of the Structures Lab is to support FHWA's strategic focus on improving mobility through analytical and experimental studies to determine the behavior of bridge systems under typical and extreme loading conditions. These experimental studies may also include tests of bridge systems developed to enhance bridge durability and constructability over time. Data from these studies help upgrade national bridge design specifications and improve the safety, reliability, and cost effectiveness of bridge construction in the United States. The Structures Lab also provides bridge failure forensic investigation services to State Departments of Transportation, FHWA Division Offices, National Transportation Safety Board (NTSB), and others. Through this forensic service, the lab determines the causes of bridge structural failures and develops practices and procedures to help avoid similar failures from occurring in the future.

DESCRIPTION

The Structures Lab has the capability to perform a broad range of tests to characterize the performance of bridge structures and structural systems. This capability resides in five individual laboratories: the main structures lab, the annex structures lab, the outdoor testing facilities, the computer modeling and simulation lab, and the metallic material testing lab.

The main structures lab is a state-of-the-art facility for indoor testing of full-scale bridge structures and large components. This lab, built in 1984, consists of a strong floor with a universal loading frame whose configuration can be customized to erect and test full-scale bridges. This strong floor measures 55.2 by 15.5 m (181 by 51 ft) and includes a grid of 573 tie-down holes. Two 178-kN (20-ton) overhead cranes service the entire floor area and can operate separately or together to unload trucks, erect structures, and set up experiments.

The annex structures lab—the original Structures Lab—was built in the 1960s, and it is still operating to provide additional testing capability. The annex structures lab has a strong floor area measuring 3.7 by 12 m (12 by 40 ft) and one 89-kN (10-ton) overhead crane.

The Structures Lab's outdoor testing facilities, consisting of permanent geosynthetic reinforced soil abutments and an outdoor strong floor, were constructed during the late 1990s to provide additional capacity for testing large-scale components subjected to environmental loading. The permanent test abutments cover a single 21.35-m-long (70-ft-long) span with a width of 3.95 m (13 ft), and the outdoor strong floor measures 7.6 by 9.2 m (25 by 30 ft).

The computer modeling and simulation lab allows researchers to build and analyze detailed models that are capable of simulating experimental test results with very high accuracy.

The metallic material testing lab is used to evaluate a wide variety of material properties of small test specimens, including fracture toughness, fatigue resistance, and strength. The laboratory also allows researchers to microscopically examine fracture surfaces and the microstructures of metallic materials and welds.

These five individual laboratories continue to be used for:

- Fundamental research into the strength, fatigue resistance, serviceability, and safety of bridge structures and components.
- Applied research to assess the suitability of various structural components and systems for different services.
- Field evaluation of in-service structures.
- Forensic evaluation of structural failures.
- Systems integration at super- and substructure interfaces.

LABORATORY EQUIPMENT

- Numerous static load actuators of 4,540- to 454,000-kg (10,000- to 1,000,000-lb) capacity. Numerous dynamic load actuators of 10,000-lb to 220,000-lb capacity.

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, Virginia. Information on TFHRC is available on the Web at www.tfhrc.gov.

This RD&T fact sheet provides concise information about a TFHRC facility.

- Numerous dynamic load actuators of 4,540- to 99,880-kg (10,000- to 220,000-lb) capacity.
- State-of-the-art data acquisition with the capability to perform very large structural experiments with thousands of channels.
- Numerous instruments to measure load, displacement, rotation, and strain in structures.
- Three mechanical testing and simulation servo-hydraulic load frames, a Charpy V-notch tester, two hardness testers, and a drop tower.
- Microscopes and metallurgical testing equipment.
- Portable telemetric data acquisition systems for field instrumentation of structures.
- Software licenses to perform advanced, nonlinear finite element modeling of structural behavior.

LAB ACCOMPLISHMENTS

Recent Activities

- Developed improved specifications for designing and analyzing horizontally curved steel bridge structures; provided the experimental data and analyses to support the American Association of State Highway and Transportation Officials' (AASHTO) development of the new Load and Resistance Factor Design Specification.
- Helped develop the 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 the 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.
- 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., the Hoan Bridge fracture failure (WI), I-664 in Hampton Roads (VA), Case Bridge (DC), and the Woodrow Wilson Bridge (VA, MD, DC).
- Assisted the National Transportation Safety Board with the investigation of the collapse of the Fowler Bridge (NY).
- Assisted in the National Transportation Safety Board investigation of the collapse of the Boston Tunnel ceiling (MA).

Current Activities

- Optimizing and evaluating ultra-high-performance concrete bridge girder performance.
- Developing modular steel bridge systems for rapid construction.
- Investigating the fatigue resistance of galvanized steel pole and sign structures.
- Evaluating the strength and creep resistance of epoxy chemical anchor bolt systems under sustained loads.
- Developing design and performance specifications for the structural use of lightweight concrete in bridge decks and components.
- Assisting the National Transportation Safety Board investigation of the collapse of the I-35W Bridge (MN).

Future Activities

Researchers in the Structures Lab will continue working to understand the detailed benefits and effects of the new generation of structural materials applied to bridges. The primary focus of the structures research program will be to define and evaluate candidates for the Bridge of the Future—a bridge that is much more durable and more easily fabricated and constructed than current bridges. These efforts will concentrate on bridge systems—from the foundations to the parapets—rather than individual bridge components. The Structures Lab is uniquely suited to perform this work because of the staff's broad expertise and the facility's design, which accommodates full-scale structural testing in a controlled environment.

PARTNERS AND CUSTOMERS

The Structures Lab continually collaborates with other research institutions, AASHTO, individual States, and industry organizations to reduce cost and promote the 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 (NCHRP), the American Iron and Steel Institute (AISI), and the National Steel Bridge Alliance (NSBA).
- The high performance steel fatigue and fracture study is being performed in partnership with the U.S. Navy and AISI and directly supports FHWA's Innovative Bridge Research and Construction Program.

Past partners include industry organizations (American Concrete Institute, AISI, American Institute for Steel Bridge Construction, and the NSBA), research institutions (Catholic University, California State University-Long Beach, George Washington University, Georgia Tech, Lehigh University, University of Maryland, University of Nebraska-Lincoln, and the Virginia Transportation Research Council), and State departments of transportation (Colorado, Iowa, Nebraska, New York, Tennessee, Virginia, and Wisconsin).

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