U.S. Department of Transportation
Office of the Secretary of Transportation

UTC Spotlight

University Transportation Centers Program

This month: Rutgers University | March 2015

The BEAST Is Coming

Rutgers CAIT creates world's first full-scale accelerated testing facility for bridges

Rutgers Center for Advanced Infrastructure and Transportation (CAIT) is unveiling the world's first facility that will quantitatively measure the effects of environmental and traffic loading on full-scale bridge deck and superstructure systems in a greatly accelerated time frame: the Bridge Evaluation and Accelerated Structural Testing lab, aka... the BEAST.

This massive project epitomizes Rutgers CAIT's commitment to advancing state of good repair by addressing what is one of the most critical infrastructure issues facing our country: the fact that nearly 24 percent of U.S. bridges are deemed either functionally obsolete or structurally deficient.

The Federal Highway Administration calculates more than 30 percent of existing bridges have already exceeded their 50-year design life. In just 10 years, 44 percent of the 610,749 structures in the current U.S. bridge inventory could be 55 years or older. That means the challenges we face now will be even more daunting in the future.

2014 Allison Thomas/Rutgers CAIT

First concrete pour for the foundation of the BEAST. It is being constructed on Rutgers' Livingston Campus in Piscataway, NJ. Railroad Construction Company, Inc., is the contractor for this portion of the project.

Rebuilding the 63,300-plus bridges presently rated structurally deficient is impossible in both practical and financial terms, so we need to extend the service life and performance of bridges we have now. In order to do that, we have to figure out the best rehabilitation and maintenance techniques, materials, and management strategies to maximize the useful life of our current assets and make sure the bridges we do rebuild now last 100 years or more.

2014 Industrial Motion Art for Rutgers CAIT

Aerial concept image of the BEAST, the world's first facility to quantitatively measure the effects of environmental and traffic loading on full-scale bridge sections in a greatly compressed time frame. The BEAST will be completed this coming spring.

But, how do we know the choices we make today will still be the right ones 10, 20, or even 30 years from now? Everyone wishes there was a crystal ball that would show us how materials and structural components will perform in the future, especially bridge owners with the weight and responsibility of the public's safety and millions of tax-payer dollars resting on their shoulders. With the BEAST, CAIT and its partners are creating a reliable, repeatable means to quantitatively measure and project future performance, providing much-needed information on which to base crucial decisions.

The BEAST subjects full-scale bridge decks and superstructures to extreme traffic loading and rapid-cycling environmental changes around the clock, "compressing time" to induce and speed up the deterioration process.

Relentlessly inflicting what amounts to 24-7 truck traffic with a 60,000-pound loading device and accelerated temperature fluctuations from 0 to 104 °F, the BEAST will fast forward aging as much as 30 times, allowing us

to simulate 15 years or more of wear and tear in just 6 months.

Data from BEAST testing will provide insight, help manage expectations, and give bridge owners empirical evidence to optimize decisions that will maximize the life cycle of bridges throughout the country—all sooner than ever thought possible.

Ultimately, what the BEAST can teach us will significantly improve public safety, facilitate U.S. commerce and economic growth, and save potentially billions of dollars in infrastructure costs.

Specifications

- Test specimens up to 50 ft long by 28 ft wide
- Traffic loading cycles with 20 to 60 kips continuous at 20 mph; 48,000 cycles per day
- 0 to 104 °F temperature fluctuation
- Salt brine application, 1 to 15 percent soluble solution

Testing Capabilities

- **Superstructures** including steel, timber, composites, and reinforced, precast or prestressed concrete
- **Deck systems** such as exodermic (e.g., open, filled, or partially filled grid decks), orthotropic or other metal deck systems, and prefabricated or precast decks
- **Concrete mix designs** (e.g., self compacting, high performance) and concrete additives, supplements, sealants, and coatings
- **Rebar** (all types, e.g., epoxy coated, galvanized, stainless, carbon fiber polymer, etc.)
- **Bridge system components** such as prestressing and post-tensioning strands, bearings, joints, and drainage systems
- **Safety devices** (e.g., reflectors, audible warnings, striping paint, signage materials, etc.)
- **Sensors** (e.g. ITS devices, condition monitoring sensors, traffic cams, etc.)

2014 ARA for Rutgers CAIT

The main element of the BEAST comprises two parallel 'I' beams 120 ft long by 7 ft tall that rest on rolling support towers that allow it to be moved out of the way when lowering test specimens into the chamber. The beams and support towers weigh 112,000 pounds. The loading chassis, which will exert a 60,000-pound load on the test specimens is shown below the beams.

About This Project

CAIT and its partners, New Jersey Department of Transportation, Rutgers School of Engineering, and Applied Research Associates, developed the BEAST over a period of more than 3 years. Countless contributors were involved in the development, fabrication, and construction of this truly unique facility. CAIT director Ali Maher, Ph.D., and associate director Patrick Szary, Ph.D., spear-headed the effort; project manager Andrés Roda, P.E., coordinated construction along with Rutgers University Facilities and Capital Planning. For more information on the BEAST and inquiries regarding testing, contact Ali Maher (mmaher@rutgers.edu).