RUTGERS
Center for Advanced Infrastructure and Transportation

Innovative solutions to optimize U.S. infrastructure durability, resilience, and life-cycle costs

Center for Advanced Infrastructure and Transportation

USDOT Region 2 University Transportation Center

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CAIT works to preserve and improve the structures and systems that keep our country mobile and prosperous.

With a variety of research, education, and tech transfer activities, our researchers and engineers address the most critical infrastructure challenges we face now and in the foreseeable future: transportation asset management, infrastructure health monitoring and rehabilitation, mobility, safety, resilience, and economic and environmental sustainability.

Situated amid the most densely populated and heavily traveled region in the United States, CAIT's proximity to the nation's third largest port, the busiest rail line, and five major international airports, allow the center to use the entire region as a multimodal test bed. This gives CAIT the distinct advantage of being able to move research quickly from the lab into the real world, where practical solutions are needed to address real-world problems.

Supported by government, industry, and academic partners, CAIT strives to make the country's infrastructure safer, more durable, and more efficient.

CAIT by the numbers

Human resources

47	Professional and technical staff (self supported from grant funds)
12	Full-time Rutgers tenured faculty researchers
90+	Affiliated faculty researchers
≈ 35	Part-time continuing education instructors & paraprofessional staff
≈ 20	Full-time graduate assistants (annually)
≈ 43	Hourly undergraduate student research assistants (annually)

Physical facilities

16,000 sq ft	CAIT headquarters: includes a fully appointed 106-seat auditorium; training classroom with 24 workstations; research and support offices for staff, administrators, and faculty working on CAIT research projects; a small library; and meeting spaces
2,900 sq ft	Additional research & support offices
4,066 sq ft	Workforce development and training space
24,520 sq ft	Laboratory space

Program Highlights

Remote sensing and nondestructive evaluation for infrastructure condition assessment • After Hurricane Sandy in October 2012, CAIT funded a project that surveyed the hardest-hit areas of New Jersey and New York using ground-based mobile lidar, a technology that uses lasers to record millions of spatial points as the light bounces off structures and other solid objects. When processed, these data create a pinpoint-accurate virtual reality—a historical record of storm damage to the built environment—like the one pictured to the left.

The Superstorm Sandy study validated the efficacy and usefulness of this data. So, CAIT deployed researchers again in the wake of hurricanes Harvey, Maria, and Michael to learn more. With lidar and drone-deployed imaging, they surveyed many miles of coastline and affected communities, recording the devastation to structures and landscape features and topographical changes due to soil/sand displacement and scour, all of which pose serious threats to roads, bridges, and underground utilities.

The processed data is useful for post-disaster clean-up operations, expediting reconstruction, and planning mitigation strategies, and, it helped FEMA recalculate its inundation risk information system. Accurate recreations of past hurricanes' devastation also give us a clearer picture of how to prepare for coastal storms we can expect in the future.

Current and future roadways • Pavement research improves existing regional infrastructure, builds a case for taking care of our roadways, and looks at innovations for the "road of the future" as well.

A CAIT pavement expert recently found a new reason to keep our pavements smooth and pothole-free: because it reduces air pollution. To quantify the environmental benefits, he did life-cycle assessments of three commonly used maintenance treatments, which included calculations of CO_2 emissions generated during their construction. He found smoother road surfaces can reduce greenhouse emissions by up to two percent. In addition, it allows transportation agencies to cut spending by 10 to 30 percent and for drivers to save two to five percent in fuel consumption, tire wear, and vehicle repairs.

In another study, researchers developed a system to convert traffic movement into electricity. The system they devised captures kinetic energy of vehicles using piezoelectric material or relative movement in an electro-magnetic generator. They also observed that significant solar energy absorbed by pavement could be harvested using photovoltaic cells, heat flux, or thermoelectric material.

CAIT's pavement resource program lab is the only independent, university-based asphalt lab in the New York/New Jersey metro area that has been accredited since 2006 by the American Association of Highway Transportation Officials (AASHTO). Our research engineers do laboratory evaluations, field testing, forensic analysis, mix designs, and specifications—all in the name of safe, quiet, cost effective, and long-lasting roadways.

Bridge Evaluation and Accelerated Structural Testing lab • The BEAST is the first facility in the world that can quantitatively measure effects of traffic and the environment on full-scale, real-world bridges. Subjecting a specimen to extreme loading and rapid-cycling temperature fluctuations—in a climate-controlled enclosure around the clock—induces and speeds up deterioration. Accelerating the wear and tear shows us how various bridge designs, materials, components, and rehabilitation methods will perform for decades in the future. The BEAST can give bridge owners empirical data in months rather than years of field observation, letting them make operational and budgetary decisions with a high level of confidence. Ultimately, what we learn from the BEAST could effectively maximize the life cycle and performance of bridges and potentially save billions of dollars in infrastructure costs.

Bridging the gap between today's and tomorrow's vehicles • In 2018, Governor Phil Murphy put forth his vision for the Innovation Hub, an incubator for scientific and technological research and cutting-edge tech startups that would be an engine for New Jersey's economic future.

New Brunswick was selected as the site for this initiative because of its ideal confluence of high-density multimodal transportation systems, including the Northeast corridor rail line; world-class medical institutions; an established corporate community; and, of course, Rutgers, the state's premier public research university.

Within the 12-acre downtown area, CAIT plans to implement technologies comprising a test bed for advanced driver assistance systems (ADAS) and automated driving systems (ADS). Rutgers researchers propose to outfit the site with high-resolution digital and radar cameras, smart intersections and pavement markings, and other mobility data-gathering and data-exchange technologies that will facilitate vehicle-to-vehicle and vehicle-to-infrastructure communications. An extensive network of sensors and the computing infrastructure to process, analyze, and make use of vast amounts of mobility data is crucial to the future integration of autonomous vehicles, a safer pedestrian and cycling environment, and robust public transit.

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