Center for Advanced Infrastructure and Transportation
Newsletter Issue 9 • July 2011

RUTGERS

transportation today

>> New Jersey: Bridge research capital of the world?

International meeting of the minds on a span in the Garden State

inside

There's an unassuming pair of steel stringer bridges in northern New Jersey that seem just like thousands of bridges all over the country—spans we drive over every day, often without noticing. But there's something about these particular sister bridges that distinguish them from every other bridge in the world: they are the focus of the International Bridge Study (IBS).

The IBS initiative is bringing together experts and researchers from around the globe to share technologies, methods, and best practices in order to better understand the complex forces that make bridges age and deteriorate—and how to deal with them.

People and businesses everywhere depend on transportation networks for just about every product, service, and activity you can think of. From the food on your table to a speedy route to the emergency room, surface transportation systems drive economies and give us unhindered mobility without which our high quality of life would not be possible. Roadways are by far the most heavily relied upon way to transport people and goods, and bridges are the critical links that tie this extensive network together.

So, how does wheeled vehicle travel compare with other modes of transportation? A staggering 2.97 *trillion* vehicle miles (a vehicle mile equals one vehicle driving one mile) were driven in the United States in 2008, versus 38.6 billion

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director's message >>

Making the most of what we have and making a difference

This issue of *Transportation Today* is all about bringing people together to accomplish great things.

There is little, if any, relief in the economy and we are all being asked to do more with less. They say necessity is the mother of invention, but even in the best of times, CAIT has always made the most of the precious little we have by leveraging resources, relationships, and knowledge and joining ranks with colleagues near and far.

Case in point: The International Bridge Study (IBS). Optimizing relationships and resources we have gained as lead on the Long-Term Bridge Performance (LTBP) program, and taking advantage of our own expertise in NDE technologies, about a year ago we joined Drs. Emin Aktan and Franklin Moon from Drexel University to initiate this unique project. We know bridge inspection and health monitoring practices vary the world over and that there's been an exposion of new technologies in the past decade. We also know the vast majority of bridges in America have reached "middle age"and with each passing day, they get older. The premise of the IBS was to bring bridge engineers from all over the world to one specific bridge so we could learn from each other.

Just a few weeks ago, the many months of field testing by teams from Asia, Europe, and North America culminated in a two-day workshop. As our cover story describes, this was a huge success. The outcome of this effort will be a set of guidelines for applying technology to assess and monitor infrastructure condition, and a common vocabulary to communicate about how best to use it, not just in the U.S., but all over the world.

IBS is just one example of the good that can come out of collaborative research—sharing resources, pooling talent, helping to establish best practices, and putting what we learn in the lab into practice.

Another example is the road safety audits (RSAs) CAIT coordinates that bring engineers, planners, law enforcement, and community activists together to make neighborhoods safer. You can read about an RSA in Newark on page 18. Or, as you can read on page 5, how for the first time in New Jersey, CAIT brought together transportation providers and planners with teachers and advocates for developmentally disabled adults to discuss improving mobility for this often overlooked population.

While our country's next surface transportation legislation is being drafted—and no doubt debated—CAIT perseveres in keeping existing infrastructure in good repair, keeping people safe, keeping technology moving forward, and keeping our eye on the future.

Ali Maher, Director ■

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rail miles and only 6.4 billion air miles (Source: *Pocket Transportation Guide, 2009*).

At the risk of overstating the obvious, our roads and bridges are aging rapidly. The American Society of Civil Engineers has been reminding us for years now that bridges were traditionally built to last 50 years; the average age of bridges in the United States is now 43 years, and about 24 percent of the population is even older. Transportation for America, a broad coalition of real estate, environmental, public health, business, and transportation interests, writes on their website (t4america.org):

> *Despite billions of dollars in federal, state, and local funds directed toward the maintenance of existing bridges, 69,223 bridges—11.5 percent of highway bridges in the U.S.—are classified as "structurally deficient." … While Congress has repeatedly declared bridge safety a national priority … the current level of investment is nowhere near what is needed to keep up with our rapidly growing backlog of aging bridges.*

In short, with bridges all over the world—not just America—we are facing a problem that's going to get worse before it gets better. We need answers on how to extend their service lives, and we need to pool as much brain power as we can to get those answers as quickly as possible.

International approach to a global problem

In June 2010, CAIT initiated the IBS—an opportunity for engineers and researchers from all over the world to study one bridge on which they could test, compare, and contrast various technologies to assess, diagnose, and monitor bridge condition.

Leveraging CAIT's position as team leader on the FHWA Long-Term Bridge Performance (LTBP) program—the largest bridge research contract ever awarded by the agency—the center invited the international bridge community to perform round-robin testing on a pair of multi-girder steel stringer bridges on Route 23 in northern New Jersey. This bridge was selected because it was already exhibiting a number of

Cover photo: The team from Drexel prepares for forced vibration testing using a drop weight device of their own design that exerts as much as 30,000 pounds of force on impact. Response of the structure during this testing was compared to readings taken during live load testing to ensure reliability of the experiments.

Right: CAIT NDE team member Hooman Parvedah (far right) monitors progress of "The Stepper" robot, which is deploying three-point impact echo testing on the IBS bridge. In the background, Drs. Moon and Gucunski talk with WNBC reporter Brian Thompson.

performance deficiencies shared by many steel bridges older than 25 years.

Over the course of several months, teams from Asia, Europe, and North America visited the New Jersey bridge to conduct field tests, assess its performance, and develop hypotheses on the potential sources of the bridge's identified deficiencies. These experts performed a series of experimental studies (including dynamic monitoring, controlled dynamic testing, and controlled load testing) within the context of Structural Identification (St-Id) to identify the root causes of deterioration and propose mitigation strategies. St-Id, a key tool for structural health monitoring, refers to any systematic approach for identifying structural parameters through the use of input and/or output test data.

Drexel engineers monitor amplitude of vibrations on the Route 23 bridge during testing using an instrumented sledge hammer and accelerometers placed on the deck.

Intercontinental engineering mind meld

Now, a year later, the teams met again for another week of testing beginning on June 6 and a two-day workshop, June 14–15, to collectively review what they have learned and "share and compare" their technologies and approaches. The second day of the workshop, discussions focused on formulating best practices and how to proceed with developing guidelines for leveraging technology on a global scale. Specific assessment and remediation recommendations for the Route 23 bridge and how other bridges with similar design and construction characteristics could benefit from what was learned to date also were discussed.

Participants in the IBS included industry, government, and academic teams from Austria, Canada, China, Great Britain, Japan, Korea, Switzerland, and the United States.

In addition to the teams directly involved in the IBS testing, representatives from the Federal Highway Administration (FHWA), New Jersey Department of Transportation (NJDOT), technology providers, and a range of engineering firms joined in discussions at the workshop. In total, 68 experts gathered to discuss their findings on the Route 23 bridge and how to move forward with applying technology to improve bridge monitoring and rehabilitation across the board.

Drs. Firas Ibrahim and Hamid Ghasemi from FHWA's Turner-Fairbank Highway Research Center addressed the group. They stressed the value of international collaboration and exchange and how the IBS can inform the ongoing work of the LTBP program.

Dr. Franklin Moon of Drexel University played a significant role coordinating the project and organizing the conference. Moon credited his mentor, Dr. Emin Aktan, also from Drexel, with the vision for the IBS. Aktan, a widely respected expert with far-reaching international relationships, approached CAIT Director Ali Maher with the idea for the study more than a year ago. It was Aktan who rallied participation from around the globe and was the linchpin of the study.

Why this bridge?

To properly assess the value of various technologies that can inform decisions regarding the renewal, preservation, or replacement of

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existing bridges, the IBS needed a bridge that displayed widespread performance issues for which root causes and effective mitigation approaches were unknown.

The team worked closely with NJDOT to identify several candidate bridges that had significant performance problems they weren't certain how best to address, and narrowed it down to 15 they felt needed support. Secondary selection criteria for the test bridge included: the significance, pervasiveness, and number of performance problems; commonality of the bridge type; availability of historical documentation (e.g., maintenance records since construction); significance of load rating and inspection challenges; and ease of access.

The project team reviewed inspection reports for the candidate bridges, examined their relation to the overall bridge population within New Jersey, and did site visits. NJDOT and the IBS organizers settled on sister multi-girder steel stringer bridges built in 1983 and 1984 that carry State Route 23/U.S. Route 202 through Wayne, New Jersey, approximately 30 minutes west of New York City. These structures currently display very common problems associated with approach settlement, bearing alignment/walking, substantial vibration, and fatigue cracking. In addition, the bridges have a variety of geometries including skew, partial skew, and straight spans that traverse a park, giving researchers easy underside access.

The test bridge was selected specifically for the IBS, but the approach employed also represents an ideal method for selecting any structure for technology applications. Bridge owners aren't necessarily interested in testing their "worst" bridge (where replacement is most likely the only feasible option), but rather a bridge that has significant performance concerns for which the appropriate remedial path is unclear. The other, and perhaps more important, approach to selecting bridges for study is when a sizeable number of bridges have similar issues or there is significant uncertainty as to the best preservation/renewal practices for a broad population of bridges. If that is the case, then a prescribed sample of bridges in question may be selected, the goal being to generate generic results that may be applied to the entire population. (There are approximately 2,900 other steel stringer bridges in New Jersey.) This has the potential to pay huge dividends, but there are very few entities with the knowledge and ability to enact that approach; hence, the benefit of pooling international talent, knowledge, and methods.

What guides bridge evaluation now?

Right now, the "go-to" guide in the United States is the AASHTO *Manual for Condition Evaluation of Bridges*, which covers major topics such as inspection procedures and load testing and rating. Although it provides general "macro" guidance, elements it lacks include detailed but accessible information on various tools available, experimental approaches, and a framework for using the available technologies, especially in relation to short-term structural tests. The AASHTO manual also does not address simulation models, model-experiment correlation, or approaches for data processing and interpretation.

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Above: Grad students monitor vibration measurements from sensors placed on the underside of the structure. Vibrations on the IBS bridge registered as high as 0.4g, the equivalent of a minor earthquake. Excessive vibration can contribute to premature deterioration.

Left: Teams from Korea take readings from the sensors and strain gauges placed to measure vibrations and other forces on the bridge during normal traffic conditions.

>> Access and awareness are the ticket to autonomy

CAIT conference promotes mobility for people with autism

Trains roaring by, strangers jostling, automatic doors snapping, a blur of numbers on glaring monitors, and buzzing fluorescent lights. For most people this is the normal clamor of a bus or train station. They barely notice it as they go about the routine of getting from point A to point B on public transit. But for someone with autism spectrum disorder (ASD), these intense sensations can be frightening and disorienting.

On top of the sensory overload, they must overcome confusing routes and timetables, difficult fare calculations, and a sea of indifferent and unfamiliar faces.

Often diagnosed as children, individuals with ASD routinely receive education that covers basic skills in math, language, and social interaction. But this curriculum is sometimes weaker in teaching the life skills they will need as adults, such as understanding and using public transportation to get to and from the store, the bank, or their job. So even when young adults with ASD become capable of living independently, they too often find they lack the mobility and confidence they need to live their lives fully and freely.

Better tools and training for transit operators, concerned parents, and teachers to identify and teach individuals with autism the skills they need to use various transportation options would help fill this gap. CAIT is working to develop a web-based standardized transportation skills assessment tool that will identify not only what task-specific skills are necessary to use various transportation options and determine the most appropriate ones, but also will address the level of skills required to do so safely and confidently, and will illuminate deficiencies and training improvements that could help autistic individuals gain access to the least restrictive option, and in turn open wider possibilities for employment, education, and socialization.

The first step in doing this is to bring together all the players: transit providers, planners, parents, advocates, teachers, and adults with autism. To this end, CAIT held the first "Transportation Options for Individuals with Autism and Related Developmental Disabilities" conference at Rutgers on April 20. The hope was to spur an essential recognition and unity among the entire community to work at improving current transportation services and education.

New Jersey legislators, disability advocates, support personnel, transportation management, parents of children with ASD, and members of New Jersey Autism and Autism Speaks attended the conference, which encouraged collaboration and communal understanding. The goal is to integrate transportation accessibility, training, and life skills education.

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<< p5 Transportation for individuals with autism

During opening remarks, Assemblyman John Wisniewski and Carolyn Fefferman, a senior adviser to Senator Robert Menendez, both called upon the 150 attendees to bring educational and community issues to the attention of their political representatives.

Wisniewski encouraged the audience to educate legislators and local officials. "[Legislators] can't possibly know everything that is happening in our communities," he said. "Things get done because people educate us on the issues that are going on."

Assemblywoman Joan Voss offered her personal insight on the autism and transportation issue. Herself the mother of a child with Asperger's syndrome, she spoke about her struggles to help her son cope with using transportation as he grew into adulthood. "I want to make sure that parents don't have to go through what I went through with my son. People on the transportation side need to be educated on what these individuals need," Voss said. "Autism is not easy to recognize. … These individuals are socially handicapped, but they can become capable members of our society."

Christopher Gagliardi, special needs outreach coordinator for Assemblywoman Valerie Vainieri Huttle (see sidebar), proved to the audience that individuals with ASD can be active in their communities if they have the same access that is afforded those without developmental disabilities. Gagliardi should know—he is an adult with autism who overcame his fear of public transportation and went on to become an independent advocate. He described his childhood difficulties that often resulted in his inability to catch the school bus on time: "Eventually, my mother got tired of driving me to school, so she took me by the hand and showed me how to take public transportation to school," Gagliardi explained, recalling for the audience the challenges he faced in learning how to navigate correct bus routes and fares. Having overcome his initial struggles, he now serves as a public advocate for people with special needs and performs in theatrical productions. He regularly uses public transportation—both buses and trains statewide—to go about his busy life.

While Gagliardi showed the audience what is possible with the right attitude, education, and access, Mary Leary, senior director of Easter Seals Project Action—an organization dedicated to helping disabled individuals gain and maintain independence—served up some startling trends in her keynote address.

"There is a 40 percent difference in employment rates between people with and without disabilities," Leary said, noting that the underlying factor most often reported by individuals with ASD is the lack of easily navigable transportation facilities and options. "People with autism can't be expected to make this happen for themselves—it is the shared responsibility of life skills program coordinators, transportation managers, and the community at large.

"Our vision at Easter Seals is: 'Everyone gets a ride when they need one,'" Leary said. She suggested public transportation improvements such as clearer signage, better audible and visual stop messages, and operator sensitivity and awareness.

Leary urged attendees to take advantage of several federal, state, and local grant opportunities and initiatives, such as accessible taxis, volunteer driver and shared ride programs, vanpools, and paratransit services that can be offered within communities without direct access to large transportation hubs.

A morning panel with representatives from the New Jersey Council on Special Transportation (NJCOST), NJ Transit, and the New Jersey Travel Independent Program (NJTIP) offered information on specific programs like NJ Transit's AccessLink, and a variety of available training field trips designed help individuals understand and use the transportation options available to them.

While the morning sessions focused on collaboration, available tools, and getting involved with government initiatives, the afternoon emphasized understanding. Peter Gerhardt, Ed.D., of the McCarton School summed up the transportation issue in a simple sentence: "Not everyone with autism is the same. … If you've met one person with autism, then you've met one person with autism."

People with developmental issues face another obstacle: Their disability is not overtly visible and therefore is frequently misunderstood. As Gerhardt said in a PBS interview: "Because of the Americans with Disabilities Act (ADA) we've seen significant changes in our environment. We see handicap parking spaces, ramps into buildings, and handicap bathroom stalls … all these things that didn't exist 10 to 15 years

Left: Linda Walder Fiddle, Cecilia Feeley, Patrick Szary, Assemblywoman Joan Voss, and Assemblyman John Wisniewski (left to right) talking at CAIT's Transportation Choices for Individuals with Autism Conference.

Opposite top: Mary Leary, executive director of Easter Seals Project Action, told the audience her organization's vision: "Everyone gets a ride when they need one."

ago. As a society we've gotten very comfortable with accommodations for people with physical disabilities. With people with neurological challenges though, we're still at a loss of how to [meet their needs]."

Christopher Menente, senior program coordinator of the Rutgers' Douglass Developmental Disabilities Center, described a hurdle he feels could be cleared by better education and understanding: "People have a view of autism as this horrible, debilitating disorder … and the community needs to understand that that's not true."

Assemblywoman Voss chimed in on the various transportation resources offered and agreed that the key factor was community buy-in and understanding.

Voss said, "I'm currently working to develop more housing for people on the ASD spectrum. … Unfortunately, a lot of communities are not receptive to housing for people with disabilities. There is a 'not in my backyard' mentality." She says special needs users should be considered during the planning phases of community development rather than having to spend even more money to "retrofit" facilities to be accessible and compliant after construction is completed.

To people indifferent to—or against—initiatives to help this population, Voss offers up a pointed reference to the Golden Rule: "Never do to someone else what you don't want done to you. When you need help with something, you're going to want someone to help you. Offer the same to someone else." ■

Been there, done that

Advocate with autism tells how transportation changed his life

Among the many inspirational speakers at the Transportation Options for Individuals with Autism Conference was Christopher Gagliardi, a special needs outreach coordinator and advocate.

Gagliardi's presentation was poignant, peppered with humor, and it visibly moved the audience—perhaps even more so because he is an individual with autism. He spoke of his experience dealing with the obstacles people with autism spectrum disorders (ASD) face regarding transportation and how it is key to the ultimate goal for them as adults: autonomy and independence.

After the conference we had a chance to speak with Gagliardi and his mother, Lynda Grace Monahan. We wanted to ask him more about the role public transportation has played in his life.

"I was always bullied on the bus to and from school. I am a bully survivor," Gagliardi recalls. According to one survey, an estimated nine in 10 kids with ASD are bullied at school, enduring verbal and/or physical abuse. In Gagliardi's experience, the severity of his physical and mental torment drove him to regularly oversleep so he would "accidently" miss the school bus. His hard-working mom couldn't drive him to school every day because of her job, so out of necessity she encouraged and helped him learn to use public transit. Gagliardi says it was a turning point in his life.

For many people with ASD, communication and human interaction are tremendously challenging. Add in the sensory overload of transportation hubs, delays and changing schedules, and variable fares, and you can imagine how overwhelming it can be. But in Gagliardi's case, with determination he overcame it all and public transit empowered him to lead a much richer and more independent life.

When asked about the importance of viable and accessible transportation, Gagliardi had this to say: "It's vitally important. And I believe, as an advocate, that people need to be more aware. Independent bus companies need to be aware of what autistic people can be taught. Public transportation is essential to [overcoming] a challenge, whether physical or mental. NJ Transit [implementing] MyBus with the MyBus texting is a great start. Also SmartKey technology is a brilliant new development.

"But I think it has to be a lot more," he says. "What I am looking for is families that can give their youngsters hope and inspire them to be able to travel abroad as well as to speak up on what they can accomplish."

CAIT's transportation options conference opened the discussion to connect care providers and teachers to transportation providers so new technologies, awareness, and a meaningful discourse can make what Gagliardi achieved possible for many more like him. ■

Christopher Gagliardi shared the story of how mobility changed his life.

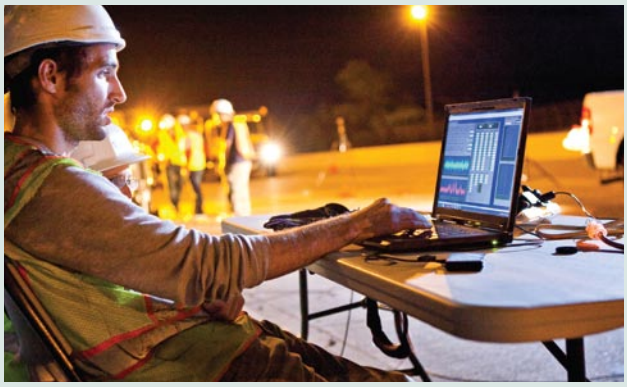
IBS Testing and Technologies

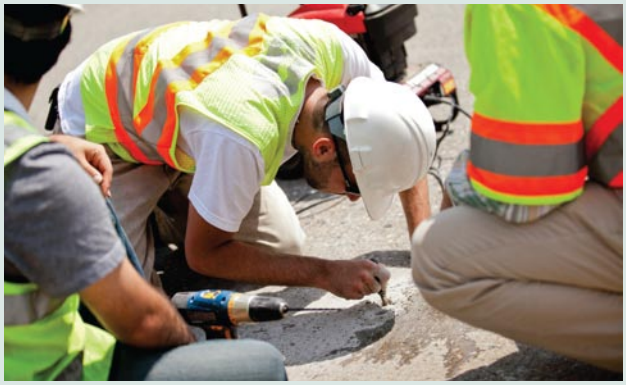
The International Bridge Study focused on several key inspection, testing, and data-gathering methods for gauging and monitoring the condition and responses of the test bridge in Wayne, New Jersey. Here are the main approaches IBS engineers and researchers employed to gather information on and evaluate the structure.

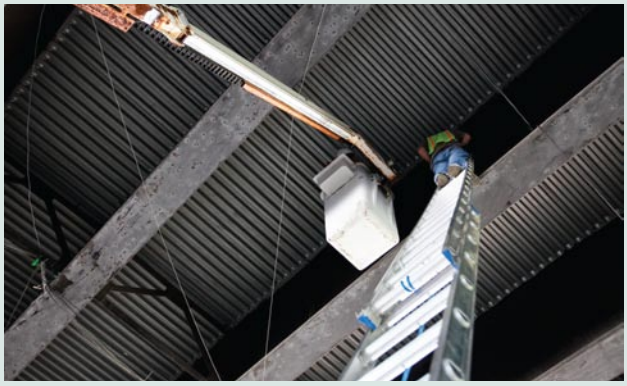
Visual inspection: By far the oldest and most widely accepted bridge assessment approach, visual inspection remains the centerpiece of all bridge management and decision-making processes worldwide. The manner in which visual inspection is carried out, however, varies greatly from country to country and continent to continent, largely due to the diversity of cultures, economies, infrastructure ages, natural hazards, etc. For the IBS bridge, visual inspections were carried out independently by six different entities from the Asia, Europe, and the United States so various practices could be compared and assessed from both cost-benefit and effectiveness standpoints.

Live load testing: The general goal of live load testing is to measure the response of a bridge under either operating traffic or a controlled loading scheme. For the IBS bridge, this type of testing was carried out using both loading approaches with the controlled loading scheme imposing a total of nearly 500,000 pounds during the final load stage. The primary responses of strains, displacements, and rotations were captured through nearly 100 sensors and displayed in real time both spatially and temporally to allow direct interpretation and to ensure safety during the testing.

Forced vibration testing: The goal of this class of experiments is to capture the modal parameters of the bridge (i.e., natural frequencies, mode shapes, damping coefficients, and modal scaling factors) by inducing vibrations and then measuring the resulting response. In the case of the IBS bridge, this testing was carried out using both large impact forces (up to 30,000 pounds) and linear electromagnetic shakers to induce vibrations. The response of the structure was captured using three independent suites of 30 accelerometers, and the results were directly compared with the response of the bridge during live load testing to ensure reliability.







Ambient vibration testing: Perhaps the most cost effective global testing technique, ambient vibration testing aims to capture a subset of the modal parameters by monitoring the vibration of the bridge under operating traffic. For the IBS bridge, this approach was carried out by eight different teams from around the world to allow variability and the various processing approaches to be compared and contrasted. These teams employed conventional wired accelerometers, two suites of wireless accelerometers, and velocity transducers, which also allowed the benefits and drawbacks of each sensing approach to be quantitatively established.

Nondestructive evaluation (NDE) methods: NDE technologies are used to examine entire structures or elements of structures and evaluate material characteristics, ensure quality/soundness, and reveal flaws. NDE tools quantitatively measure and assess materials and structures by probing mechanical, electrical, thermal, optical, or other physical or chemical properties. NDE also is essential in collecting condition data for infrastructure management systems. Some of the technologies used on the IBS bridge include ground-penetrating radar, electrical resistivity, and ultrasonics.

Simulation modeling: The development and use of 3D simulation models to forecast bridge performance and to predict behavior under various scenarios (overloads, earthquakes, etc.) is rapidly becoming commonplace. As part of the IBS, several independent teams developed, error screened, and calibrated 3D finite element simulation models using the results from the various experimental studies carried out. The model calibration approaches employed ranged from heuristic-based manual calibration to conventional parameter identification to advanced statistical approaches that generate large populations of plausible models. These models were then used to better understand the current performance deficiencies, and to develop efficient and effective retrofit or intervention strategies.

Emerging technologies: The development of technologies that may aid the diagnosis, prognosis, and treatment of bridge performance deficiencies has been expanding exponentially in recent years. While many are still in the development phase, they hold the potential to simultaneously reduce the cost while greatly increasing the value of technology applications. To explore and assess the maturity and value of some of the more promising emerging technologies, the IBS conducted a field validation study that included: various noncontact 3D geometry-capture approaches; noncontact, high-resolution displacement measurements devices; wireless sensing and data acquisition; innovative local NDE approaches; and others. ■

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Technology provides information, only *humans* can put it to use

Many tools can help engineers assess the "health" of a bridge:

Diagnostic tools, such as nondestructive evaluation (NDE) methods like ground-penetrating radar or infrared thermography, help assess the condition of a bridge. Data gathered with diagnostics sometimes is used to establish a baseline for testing going forward or, if done repeatedly, to measure the progression of deterioration on a given structure.

Sensing technologies have the ability to capture actual responses (deflection, vibration, etc.) of the bridge either during live traffic conditions or during controlled experiments in which engineers induce stress using shakers, drop weights, or heavily loaded trucks.

Information technology gives engineers the tools to process and analyze the data gathered from sensors or NDE tools; to visualize data based on spatial, time, load, or other factors; and perform direct and reliable interpretation of the data so it can be put to use.

Simulation technologies allow engineers to construct and calibrate computer models or create simulated scenarios that help them predict how a bridge will perform in the future and how similar structures may also behave.

The Drexel team prepares to perform a drop weight test on the bridge the night of June 6. Forced vibration testing was done at night to minimize traffic interfering with the experiment and when lane closures would be least disruptive to motorists.

Within each of these genres are many individual methods and tests (see opposite page). For instance, for short-term structural testing, engineers may use live load (actual traffic) or forced vibration (mechanically induced).

There also is an extensive suite of diagnostic NDE tools, for example, electrical resistivity to measure corrosion, ground-penetrating radar to detect cracks and voids, and advanced imaging techniques.

As useful as diagnostics, sensors, and computer models are in helping us gain insight to the condition and reactions of a bridge, the old saying "It's not the tools, it's the carpenter" sums up usefulness of applying any technology to bridge evaluation and performance predictions—the most important component in any system or guidelines is the cumulative experience and knowledge of bridge engineers who interpret the data. As Dr. Branco Glisic of Princeton University put it: "Bridge owners don't want data, they want information."

Above: This aerial view of the IBS bridge shows the combination of straight and skewed spans that, among other characteristics, made it ideal for the study.

Opposite, top: Jeff Weidner from Drexel University records data gathered during forced vibration testing. This data can be used in finite element models (FEM) to get a better picture of forces acting on the span.

Opposite, middle: The CAIT team drills a small tap in the deck measure to half-cell potential, which can gauge probability of corrosion of the reinforcing steel.

Opposite, bottom: Teams from Korea check data-gathering sensors mounted under the bridge.

"Diagnosis" for the IBS bridge

So what did researchers find on the Route 23 bridge? The specifics will be compiled in a report to NJDOT, but there was consensus on multiple areas of concern that could affect the bridge's performance and durability, though it was deemed safe by all the researchers. Issues noted were fatigue cracking, concerns with bearings, water infiltration, and presence of a gas line under the bridge that is potentially problematic. However, most of the discussion

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focused on the excessive vibrations that were measured in ambient and induced load tests (as much as 0.4g under normal service conditions on one of the girders). High vibration amplitude and frequency of excitation could lead to accelerated deterioration, especially if trucks are creating or adding to the resonance—a vibrational "snowball effect"—which may worsen existing fatigue cracks and other problems. The atypical vibration on the bridge could also account for pockets of delamination found in the deck, which CAIT NDE expert Dr. Nenad Gucunski says is often seen on "bouncy" bridges.

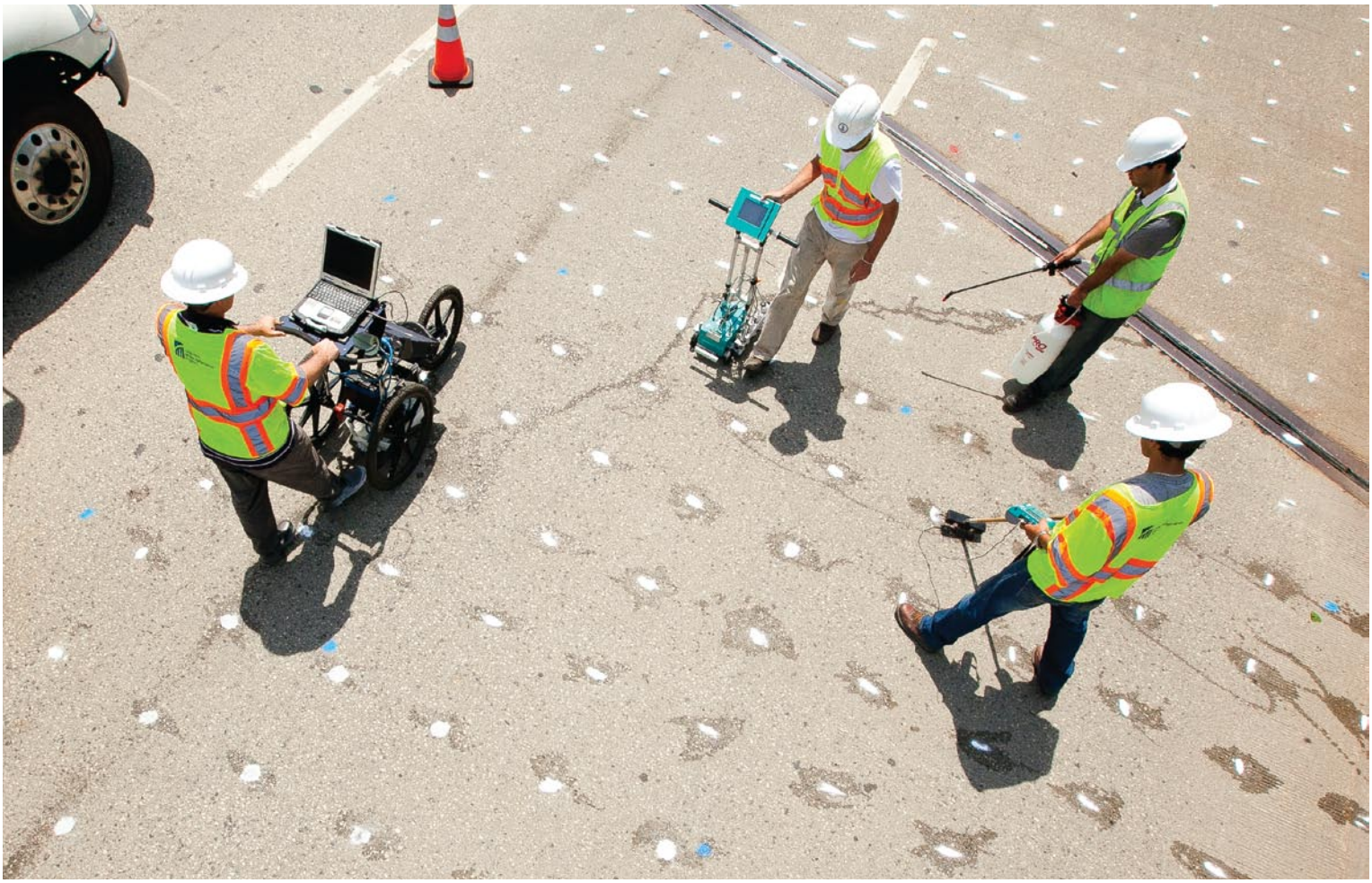
"Mapping" technology for bridge management

The collaborative efforts of the IBS will eventually render a set of guidelines that have been vetted and critiqued by international experts. This guide will ultimately aid in diagnosis, prognosis, and mitigation of performance deficiencies and reduce barriers by establishing a common vocabulary between bridge owners and those who provide and deploy technology applications.

Although many different technologies available are potentially valuable to bridge owners, the scope of the guidelines developed under the IBS will be limited to applications that involve short-term structural testing. Focus will be on three short-term testing approaches in particular: live load testing, forced dynamic testing (both impact and shaker), and ambient vibration monitoring. Authors anticipate the guidelines will be amended in the future to address NDE technologies and longer-term structural monitoring.

Some researchers hope to "complete the loop" by expanding the project into a pilot study in which intervention recommendations based on the finite element models developed could be acted upon and followed up with further testing to measure effectiveness of the selected treatment.

The document produced from the IBS—expected to be published in late August of this year—won't be a "how-to" book for using technology; rather it aims to serve as a roadmap for those who are tasked with the critical responsibilities of ensuring that appropriate technologies are properly selected, integrated, and leveraged. It will provide a detailed example of best practices that can help infrastructure owners, consulting engineers, and technicians identify appropriate ways to use technologies to improve the health and safety of bridges around the world. ■



The CAIT team conducts NDE testing using (clockwise from left) ground-penetrating radar, Moist Scan microwave technology, and electrical resistivity, which is an indicator of a corrosive environment that could lead to deterioration of rebar in the bridge deck.

>> CAIT pavement lab gets AASHTO seal of approval ... again

PRP still measures up against national standards in materials testing

CAIT's Pavement Resource Program (PRP) received official word from the American Association of State Highway and Transportation Officials (AASHTO) in March 2011 that it had successfully been reaccredited as an AASHTO Materials Research Laboratory (AMRL).

PRP director Tom Bennert, Ph.D. (left), explains some of the lab's fatigue and structural testing equipment to New Jersey Assembly staffers Maureen McMahon (center) and Glen Beebe, who visited last summer.

PRP is one of only a handful of AMRL labs based at a university. In addition to expertise in quality systems, HMA, and aggregate—areas it has been certified in since 2006—the Rutgers lab earned its first certification this year in asphalt binder, making one of only four accredited binder labs in the state; the others are at New Jersey Department of Transportation (NJDOT), Port Authority of New York and New Jersey (PANYNJ), and industry giant NuStar LP.

The accreditation means PRP meets construction-materials testing requirements for the Federal Highway Administration (FHWA), Federal Aviation Administration (FAA), U.S. Army Corps of Engineers, and the Bureau of Reclamation. The value of AASHTO certification is that it assures agencies and commercial paving companies that the asphalt for their project has been tested with strict specifications on calibrated equipment that is run by knowledgeable and thoroughly trained technicians like those on the PRP team. AASHTO accreditation isn't a one-time deal—labs must recertify every few years to ensure ongoing quality control and testing standards are compared and upheld across the nation.

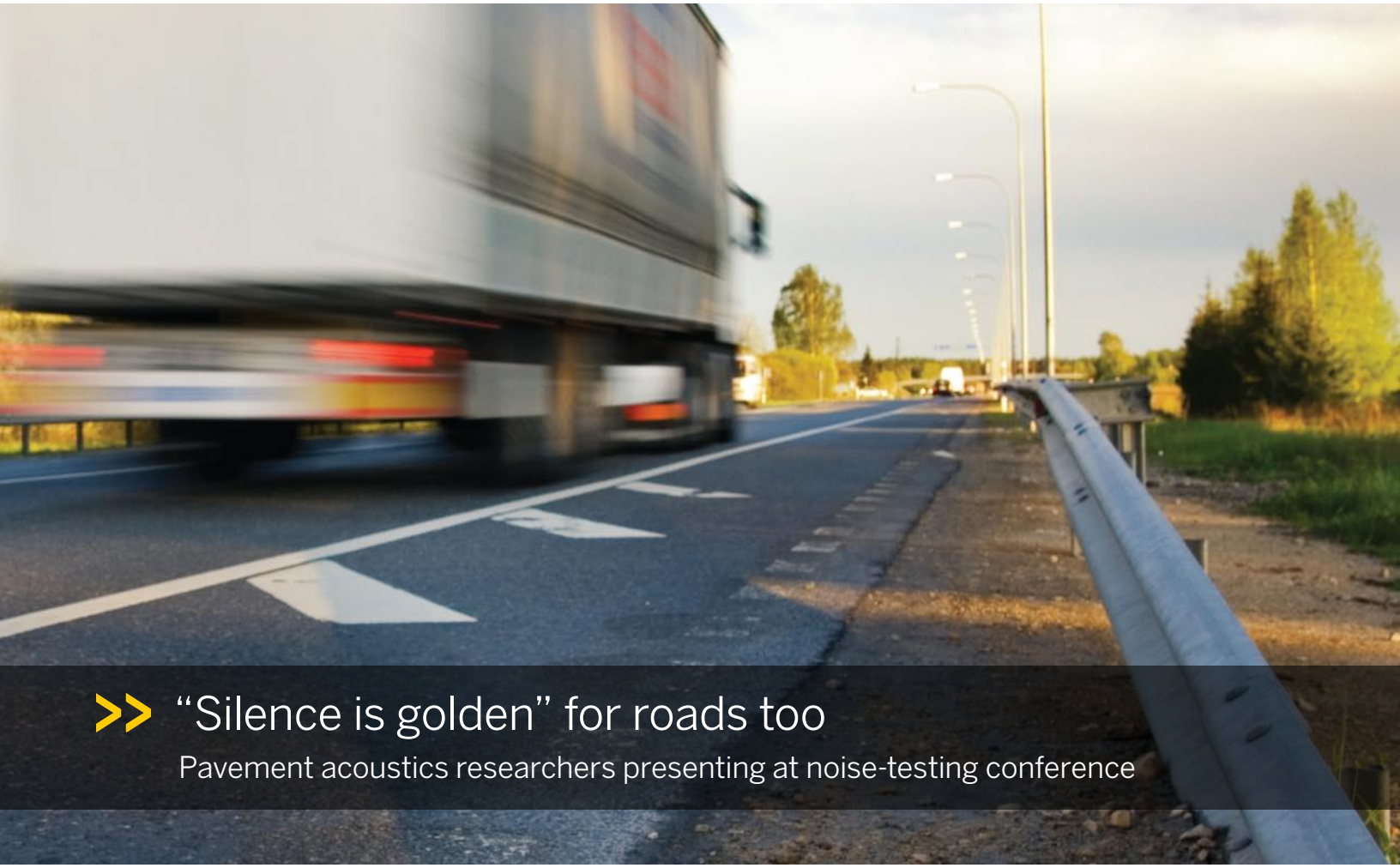
An AASHTO certification means professional leadership and exacting standards. The accreditation process demands rigorous quality control and requires an AMRL inspector to shadow—and scrutinize—every nuance of research and operation to ensure that the lab being evaluated will indeed measure up to the high standards AASHTO maintains for the industry. In addition, the lab must submit material samples to AMRL representatives to confirm that protocol and development procedures adhere to both the lab's quality management report and the perfection desired by AASHTO in production output.

Since its inception in 2001, the PRP lab has grown into a nationally respected asphalt testing and mix design facility. Program director, teacher, and paving expert Tom Bennert, Ph.D., heads up the operation and is largely responsible for the lab's exponential growth and advancement over the past 10 years.

PRP has a team of 20 full- and part-time staff and offers working research opportunities to about nine undergraduate and graduate students each year.

The lab receives approximately $1.5 million in research contracts annually—evidence of a history of confident funding sources that AASHTO certification typically brings. PRP works regularly with federal agencies like FHWA and FAA; NJDOT and other state DOTs; PANYNJ, Garden State Parkway, and New Jersey Turnpike; and a host of private industry leaders.

More on the web: cait.rutgers.edu/prp ■



>> "Silence is golden" for roads too

Pavement acoustics researchers presenting at noise-testing conference

As noise pollution increases, so do its adverse psychological, environmental, and physical effects. But growing awareness of noise emissions coming from highways and other transportation spurred CAIT's Pavement Resource Program (PRP) researchers to pursue the quietest, safest asphalt—and it's not going unnoticed.

This summer, the PRP team is headed to the West Coast to present two abstracts on noise testing methodologies at the national Institute for Noise Control Engineering (INCE) 2011 NOISE-CON event July 25–27 in Portland, Oregon.

The 2011 NOISE-CON, held jointly with the summer meeting of the Transportation Research Board (TRB), is a national opportunity to showcase research findings and share knowledge on testing methodologies to a nationwide group of noise pollution mitigation professionals. The conference will focus on noise and aural vibrations of high speed rail systems, light rail systems, highway surfaces, and aircraft.

Tire-to-pavement noise is a leading factor in roadway noise pollution. While PRP researchers use the on-board sound intensity (OBSI) method to test New Jersey roads for tire-to-pavement sound emissions, lead researcher John Hencken and his team also have developed evaluation methodologies to help other states choose the quietest and safety pavements for their roadway construction projects and upgrades.

In the first of two abstracts to be presented at NOISE-CON, "Using a Statistical Matrix with Probability to Determine Similarities between Bituminous Pavements in Massachusetts," the team outlines its development of a nearly fail-safe evaluation matrix to help the Massachusetts Department of Transportation (MassDOT) pavement engineers test and compare, among others, Asphalt Rubber Gap Graded (ARGG) pavements against Open-Graded Friction Course (OGFC) pavements for noise emissions. Since Massachusetts roads experience weather-related degradation during the winter months, the matrix must show which options have the lowest tire-to-pavement sound output with the highest weather resistance. Other states will be encouraged to adopt the comparison matrix, which boasts a confidence interval of 95 percent or greater.

PRP also intends to teach NOISE-CON attendees how to conduct noise-testing analyses within their own states. The second abstract, a tutorial designed to demystify synesthetic sound charts used in noise test evaluations, will appeal to stakeholders and contractors and let them hear and understand acoustic benefits for themselves. The session, "An Alternative Method of Presentation: Using Videos to Explain Variation in Tire Pavement Noise Spectra on Various Pavements in New Jersey," will offer graphical representations of sound measurements taken from OBSI tests to help them better understand how to read and interpret results. In this presentation, the PRP team will display a video created with 60-second audio measurements placed on top of a simultaneous video capture. The final video will be shown during the session, complete with overlays of pertinent information, so that stakeholders and contractors can identify and understand noise emitted from different pavement structures—and how that noise affects quality of life and the human psyche.

More on the web: Info on NOISE-CON at http://www.inceusa.org/nc11 ■

When you "give 'em a brake" it might be your own life you save

This year, the New Jersey Senate and General Assembly signed a joint resolution declaring April 4–8 as Work Zone Safety Awareness Week in the state.

The resolution specifically recognized Rutgers and the New Jersey Work Zone Safety Partnership for the Annual New Jersey Work Zone Safety Awareness Conference they hold as part of National Work Zone Awareness Week. CAIT's New Jersey Local Technical Assistance Program (NJ LTAP) hosted the event—now in its 12th year—on April 5.

There is an average of 2,600 work zone accidents each year that result in approximately 15 fatalities. According to the Federal Highway Administration (FHWA), more than 80 percent of people killed in work zones nationwide are drivers or passengers traveling through a work zone, hence, this year's theme was "Safer driving. Safer work zones. For everyone."

This year's conference drew a record 300 participants from the highway construction industry, law enforcement, regulatory agencies, and public works and engineering departments from across the state. During opening remarks, FHWA Assistant Division Administrator Lawrence F. Cullari, NJDOT Deputy Commissioner Joe Mrozek, and OSHA Regional Administrator Robert Kulick all commended those in New Jersey for their work in promoting work zone safety awareness, but stressed the importance of remaining vigilant. Of the 50 states, New Jersey ranks 23rd in work zone fatalities. Considering both density and extent of its roadways, that is a respectable standing.

Keynote speaker Chung Eng, work zone mobility and safety team leader for the FHWA Office of Operations, spoke about the need and opportunities to improve work zone safety, noting challenges and regulations that affect the construction industry both now and in the future.

There was a panel discussion on the role of contractors in an emergency situation, during which representatives from the New Jersey State Police, NJDOT, and two construction contractors revealed how they have handled emergencies in or near an active work zone. Questions about moving and loaning equipment and material, as well as manpower, were considered. Since there is no standard operating procedure for this type of situation, many audience members had questions and comments for the distinguished speaker panel.

The afternoon program included discussion on best practices for nighttime work zone setup. Advanced warning methods, providing public information, and demonstrations of some state-of-the-art lighting techniques were part of the presentation.

NJ LTAP has a long-standing work zone safety program that offers targeted training for law enforcement, public works, and traffic control coordinators. A cooperative effort with NJDOT and the New Jersey State Police, NJ LTAP offers training—ranging from half-day to four-day programs—throughout the year. ■

Supporting women in transportation

A Rutgers student who is definitely going somewhere

A technical tour focusing on sustainability at the Port of Oakland was one of the many activities and sessions Stringer participated in at the WTS conference.

Again this year, CAIT made it possible for a promising young engineer to attend the Women's Transportation Seminars (WTS) Conference.

Judith Stringer, an associate civil engineer in the engineering department of the Port Authority of New York and New Jersey's marine terminals, was the winner of the essay contest that earned her a ticket to San Francisco, May 18–20, for the opportunity to network with leaders in transportation. Stringer is a Rutgers graduate student studying civil and environmental engineering. Here's what she had to say about her experience:

At the 2011 WTS Annual Conference I met so many accomplished women who have achieved amazing milestones in transportation, and I brought myself one step closer to discovering the route I will pursue within the industry as a transportation engineer.

I attended many seminars, technical sessions, and tours throughout the three-day conference, including professional development workshops, a session on sustainability in aviation and airport designs, a women's discussion panel, and a sustainability tour of the Port of Oakland. Throughout the conference, I gained a vast array of valuable lessons on professional development, writing career goals, and taking control of my career path. I also gained technical insights on Leadership in Environmental Engineering Design (LEED) design possibilities, specifically relating to airport interior design and environmental mitigation at maritime facilities.

During the awards banquet on day two of the conference, U.S. Secretary of Transportation Ray LaHood officially launched the "Transportation YOU" program that hopes to spark the interest of teenage girls and encourage them to study science, technology, engineering, and mathematics (STEM) areas. This program will allow young women to discover and explore the sciences and career possibilities available to them.

On the final day of the conference, speaker Laura Ling—a reporter who in 2009, while investigating trafficking of women in North Korea, was arrested and held captive for 140 days—spoke about her struggles as a female journalist and told the story of her long, horrifying imprisonment at the hands of the North Korean government. Ms. Ling stressed the importance of staying strong and standing for the values you believe in.

There was not a dry eye in the audience as she recounted the ordeal of her captivity, but as harrowing as her story was, she definitely inspired me to continue to pursue my goals and stand firm in my aspirations of becoming a transportation engineer, despite stereotypes and the challenges of being a woman in a predominantly male profession.

I came away from the WTS Conference with a renewed appreciation for the impact that transportation has on a region's growth and prosperity and a re-energized ambition to contribute to this important field. ■

Laura Ling (left), speaker at the WTS conference, and Rutgers student Judith Stringer.

Canvas constructions: Drawing inspiration from concrete and steel

Brooklyn-born Allan Gorman has always been passionate about aesthetics. Especially the aesthetics of infrastructure—its geometry, textures, and the scale of it all—so he finds plenty of inspiration in the New York/New Jersey metropolitan area.

His paintings of architecture, structures, and machines are redolent of both the past and present. Gorman says his work celebrates the care and skill that goes into designing and building things, and their ability to evoke familiar feelings of simplicity, curiosity, and comfort. He explains, "I marvel at and try to share the powerful, angular, and interesting shapes found in the objects we've created."

Some of his works are photorealistic while others are loose and abstract. Gorman's point of view and engaging style are evocative of Edward Hopper and Charles Sheeler (both of whom depicted urban landscapes in their work), or perhaps a New Jersey version of David Hockney.

"My paintings are about the beauty found within man's industry," says Gorman. "I look [to the] interesting shapes and precision [of] man-made objects to explore form, composition, color, and emotion. For me, the images are about security and permanence and often evoke a romantic nostalgia for another time and place.

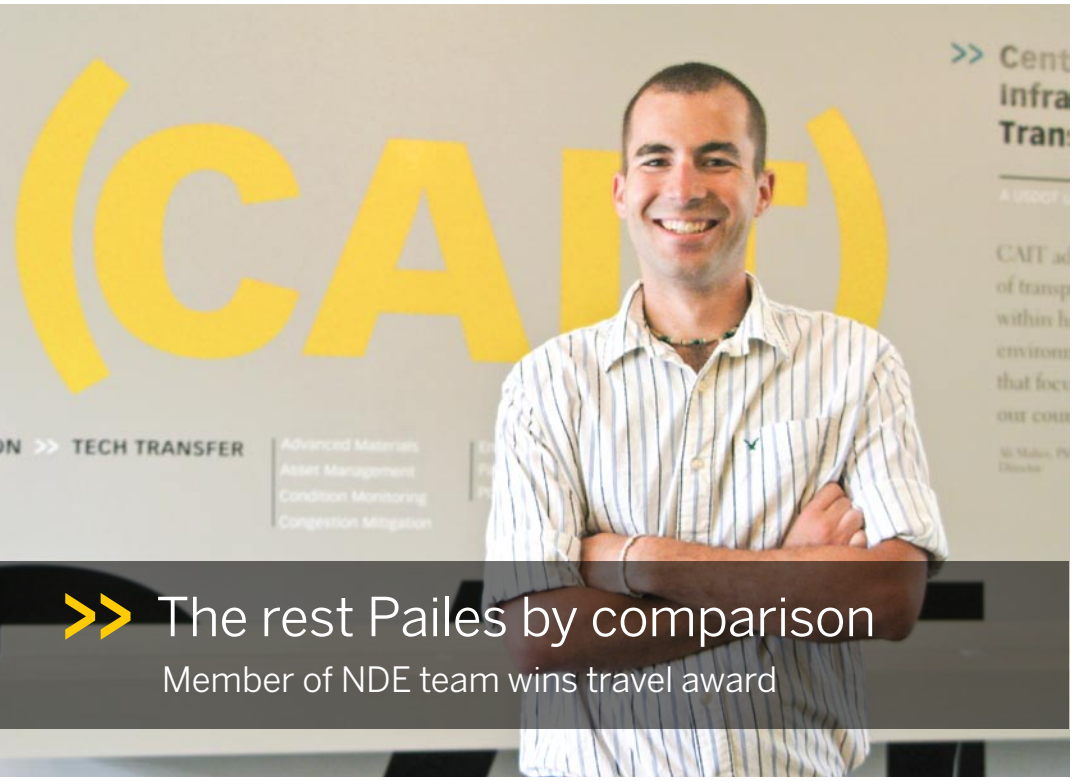
"Even as a kid, I had an affinity for man-made things linked to the past: elevated train stations, subway cars with rattan seats, propeller planes, streamlined automobiles. Now when I make my art, I'm drawn to subject matter that takes me back there—classic structures ... old photos ... and now, highways, trucks, and industrial objects. I'm attracted to timeless, classic shapes, fine craftsmanship, power, and a strong connection to the things I love."

Largely self-taught, Gorman took his first painting course at the School of Visual Arts in New York City in the mid-1980s and has only been exhibiting his work since 2009.

His art is now being shown widely, including its appearance in the New Jersey Arts Annual, a statewide survey of contemporary art at the New Jersey State Museum in Trenton, and in a solo exhibition of more than 25 works at the Brassworks gallery in Montclair. He is currently preparing new works for two more solo exhibitions and a group show at the Perkins Center for the Arts in Moorestown later this year.

More on the web: See Gorman's work and upcoming exhibitions at www.allangorman.com ■

Top: *On Old 17,* oil on linen, 36 x 24 inches, 2010.
Bottom: *Down Ramp,* oil on linen, 36 x 36 inches, 2010.



>> The rest Pailes by comparison

Member of NDE team wins travel award

The American Society for Nondestructive Testing (ASNT) wants to create a safer world by promoting the use of NDE technologies—and so does Rutgers graduate student Brian Pailes.

Pailes was one of 10 winners chosen by the ASNT that received a stipend to attend their spring conference in San Francisco. He was selected based on his application, letter of recommendation, and an essay on the role he expects nondestructive evaluation to play in his career. ASNT runs competitions to provide funding for students to attend conferences that the organization sponsors throughout the year.

ASNT is the world's largest technical society for nondestructive testing (NDT), aka nondestructive evaluation (NDE). The society has more than 70 local sections in the United States and 14 chapters internationally.

NDE is a useful tool in a broad range of manufacturing, construction, research, engineering, and military applications. Like a doctor uses X-rays or MRIs to diagnose various medical conditions, NDE methods let technicians and engineers detect flaws in structures and materials—such as cracking, concrete delamination, and various forms of corrosion—often before those defects are visible on the surface. Some of the most common NDE tools include ground penetrating radar, impact echo, infrared imaging, and electrical resistivity.

CAIT's Infrastructure Condition Monitoring Program (ICMP), one of the most respected NDE research teams in the nation, has performed testing in Iowa, California, Utah, and many other states.

Pailes' research focus is in health monitoring for bridges but he recognized the conference as a perfect opportunity to see how people in other industries—like aeronautics and home construction—were applying NDE technology. So, in addition to sessions on things like using ground-penetrating radar for bridge decks, he also learned about the use of infrared thermography in the housing market, ultrasonic testing of airplane parts, and even teaching students how new structures can be designed so that they can be better evaluated using NDE.

"I'm very thankful that ASNT provided me this opportunity," says Pailes. "To hear firsthand about research and implementation of NDE by people from around the world with many different backgrounds … and have that kind of knowledge available is priceless. Collaboration and sharing information are fundamental in the advancement of any technology. At the conference in San Francisco, I was able to do just that." ■

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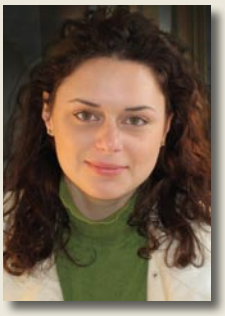
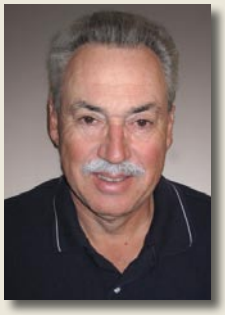


Erica Erlanger worked with CAIT as a summer intern in 2010 and joined the center full time in January 2011 as a team member in our Infrastructure Condition Monitoring Program (ICMP). In her position as a laboratory researcher, she is responsible for the nondestructive evaluation and testing lab and provides support collecting and analyzing data relating to the Long-Term Bridge Performance (LTBP) program and projects being conducted by CAIT's Pavement Resource Program (PRP). Erica also edits technical reports related to these and other CAIT programs. She graduated from Purdue University with an M.S. in geology and holds a B.S. from Union College of Schenectady, New York.



Howard W. Immordino joined CAIT as a senior research project manager in December 2010. He has a distinguished career of more than 37 years in transportation budget and administrative analysis and management and capital program planning and coordination. Howard holds a B.S. from Ohio State University and a master's from Rider University, both in business administration.

After a steady progression of promotions in several NJDOT departments, in 1993 he created the position of State Planning and Research (SPR) program coordinator and consolidated the development and monitoring of all planning, research, and management systems activities under one annual work program. Eventually he was named manager of the Bureau of Financial Management Support, responsible for overseeing the SPR Work Program, which had an annual budget of $60 million and provided financial oversight for programs of New Jersey's three MPOs and eight TMAs—a grand total of $80 million in federal and state funds.

His most recent position was as manager of the NJDOT Bureau of Capital Program Development Transportation Improvement Program and Annual Capital Program. Now retired from NJDOT, at CAIT Howard will be developing widely applicable advanced financial planning and management tools for transportation capital programs in New Jersey and other states.

Seung-Kyoung (SK) Lee, Ph.D., works at CAIT as a senior research associate. His research interests include laboratory and field studies related to corrosion of reinforcing steel and concrete; protective coatings for steel bridges; nondestructive evaluation and protection of post-tensioned tendons, stay cables, and prestressed strands; cathodic protection systems; durability monitoring sensors; and service life prediction modeling. SK formerly held the position of research corrosion engineer and manager of the Coatings and Corrosion Laboratory at the Federal Highway Administration's Turner-Fairbank Highway Research Center in McLean, Virginia.

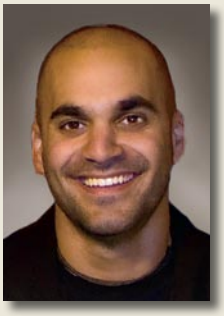
SK serves as chairman of the Transportation Research Board's (TRB) Subcommittee on Steel Bridge Coatings and is a member of the TRB preservation (AHD 30) and corrosion (AHD 45) committees. He is certified as a cathodic protection specialist and a coating inspector by the National Association of Corrosion Engineers (NACE) International. He holds an M.S. and Ph.D. from Florida Atlantic University where his studies concentrated on structures and materials.

Ryan Miller is expanding and managing CAIT's Soil and Sediment Management Laboratory (SSML). His work in this highly specialized facility will include analyzing and modeling the movement of fluvial contaminants that have been dispersed as a result of erosion and dredging in waterways.

Ryan studied environmental sciences and civil engineering at Drexel University before he earned a B.S. in environmental planning and design from Rutgers. His undergraduate concentration was in landscape architecture and ecological remediation. Currently he is pursuing a master's in transportation systems planning at Rutgers' Edward J. Bloustein School of Planning and Public Policy. Ryan's research interests focus on the relationships between infrastructure development, environmental quality, and human health. He is also a practitioner of landscape architecture and graphic design.

Patricia Ott, P.E., joined CAIT in January 2011 as a program manager and will be working to broaden the center's traffic and safety engineering initiatives. Pat earned her B.S. in civil engineering at Rutgers and has an M.S. in transportation engineering from NJIT. She recently retired from NJDOT where she was the director of traffic engineering and safety. She chaired the New Jersey Safety Management Task Force and was instrumental in developing New Jersey's Comprehensive Strategic Highway Safety Plan. Pat is a licensed professional engineer in New Jersey and is an active member of the Institute of Transportation Engineers and the American Society of Highway Engineers, Southern New Jersey Safety Committee.

Pat is using her extensive knowledge to shape a strategic safety vision at CAIT that will include multiple modes of travel. She will expand the center's transportation safety initiatives and seek to build new partnerships throughout the region and the nation.



Darius Pezeshki was hired as a laboratory researcher for CAIT's Pavement Resource Program (PRP) in December 2010. Darius graduated from Rutgers' School of Engineering in May 2009 with a B.S. in civil engineering. He got his start at the PRP asphalt lab as an undergraduate focusing on warm mix asphalt and hot mix asphalt research. As a staff member in the Rutgers Asphalt Pavement Laboratory, he analyzes fatigue and life cycle of compacted hot mix asphalt samples as well as does performance testing on other materials.

Brian N. Tobin, former executive director of the New Jersey Asphalt Pavement Association (NJAPA) and the Associated General Contractors of New Jersey (AGC NJ), joined CAIT in January 2011 as an engineering research project manager. In his new role, Brian will focus on technology transfer, specifically in the Pavement Resource Program (PRP), and will work with key stakeholders on grant proposals, legislative agendas, technology evaluation, business development, public education, and infrastructure development.

"This is a tremendous opportunity for me," says Brian, "to work hard for CAIT and the people of New Jersey. Anything I can do that will help improve our infrastructure and quality of life I consider a personal accomplishment."

Brian graduated magna cum laude from Rutgers. He was a recipient of the prestigious "Forty Under 40" award from *NJBIZ* magazine, an award that honors men and women who are leaders in their field and have demonstrated their commitment to business growth and contributing to their community.

Michael Weber joined CAIT's Transportation Safety Resource Center (TSRC) as a research project assistant in January 2011. He graduated from Rowan University with a B.S. in civil engineering in 2010. During his undergraduate studies, Michael specialized in structural engineering and participated in the ASCE Student Steel Bridge Competition.

For TSRC, Michael provides Plan4Safety training and fulfills crash-data requests. He also provides support for road safety audits (RSAs) and the Safety and Transportation Education Program (STEP) by performing data analysis that informs those activities. ■

RSA Chronicle #1: Newark, NJ

CAIT engineers improve at-risk roads in New Jersey's largest urban center

The "Brick City" is a thriving metropolis of homes, schools, and businesses. With a population of nearly 300,000—plus a daily influx of commuters—it is New Jersey's largest city. That distinction, though, comes with issues.

Newark, New Jersey—just 10 minutes outside New York City—is an urban center that is interwoven with one of the nation's most complex networks of air, rail, marine port, and highway infrastructure. As its population and the inevitable airport, trucking, and commuter traffic grow, so does congestion on the city's roadways. And, as the number of cars and trucks swells, so does the number of traffic incidents—some involving pedestrians—especially in the city's northern corridor.

Caminos Seguros, a division of the community organization La Casa De Don Pedro, serves the Hispanic community in northern Newark and works to ensure safer roadways and improve neighborhoods as a whole. After hearing from numerous concerned residents regarding the lack of safety measures, Caminos Seguros and the County of Essex sought the help of CAIT engineers to perform a road safety audit (RSA) on the areas they identified as most needing attention.

An RSA is a safety evaluation conducted by a multidisciplinary, independent team of safety professionals that considers not only vehicles, but all road users. The "product" resulting from RSAs is a set of cost-efficient, high-quality improvement recommendations.

CAIT uses a rigorous, data-driven approach in its RSAs to identify and solve roadway safety issues. Employing tools like Plan4Safety—an award-winning crash data and analysis software created by the Transportation Safety Resource Center (TSRC) at CAIT—RSA teams determined the highest at-risk area in the city according to data on number of crashes and their severity. Safety engineers from TSRC and CAIT's New Jersey Local Technical Assistance Program teamed up with planners from Rutgers' Voorhees Transportation Center, Newark police officers, and representatives from the North Jersey Transportation Planning Association, NJ Transit, NJDOT, New Jersey Division of Highway Traffic Safety, and FHWA to attack the problem. The team set

Opposite page: In February 2011, when the RSA team first visited Park Avenue and 4th Street in Newark, they spotted multiple traffic safety problems, such as lighting issues and insufficient pedestrian crossings.

Below: They returned to the same area in the spring to complete their review and make countermeasure recommendations to improve safety for motorists and pedestrians alike.

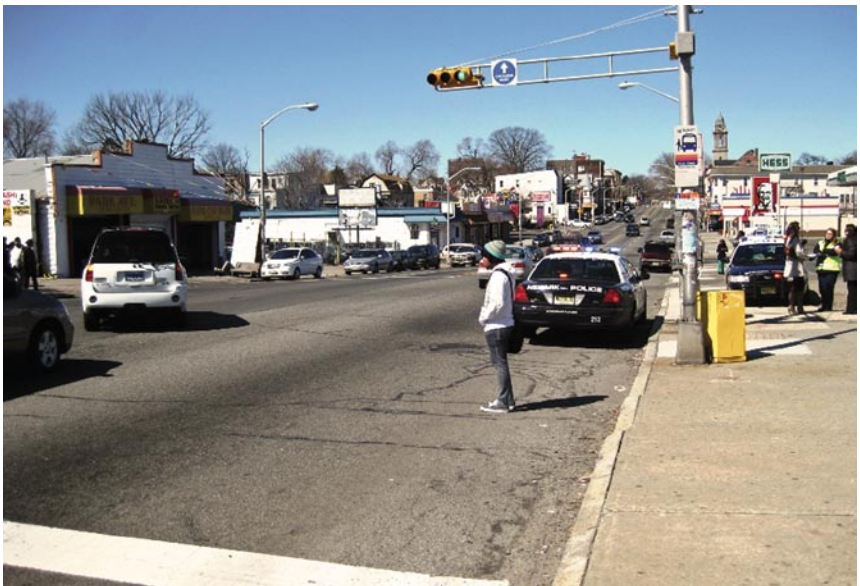
out to identify and recommend solutions to the most prominent safety issues at the intersection of Park Avenue at the merge of 4th and 1st Streets.

Park Avenue at 4th Street is a busy intersection heavily used by emergency response vehicles en route to University Hospital as well as by NJ Transit buses carrying commuters. Gas stations, car washes, restaurants, and clothing and grocery stores line the streets here, making it an area of primary concern for both vehicles and pedestrians who travel within this bustling neighborhood. TSRC's pre-evaluation found that between 2007 and 2010, 29 crashes occurred at the intersection—four of which involved pedestrians—resulting in 24 injuries. The team found that of those 29 crashes, a large number involved rear-end collisions |at the intersection, most frequently with motorists traveling eastbound. This gave the team a lead on specific items to focus on during the RSA.

The site investigation proved worthwhile since the team discovered multiple safety issues. Signal timing, roadway visibility, troublesome lighting conditions from sun glare to broken streetlamps, lack of pedestrian crosswalks and signals, and an unmarked lane merge were identified among the highest safety risks to the community. For this and all RSAs, a final report drafted by TSRC includes all of the observed safety issues and recommended countermeasures, along with the cost-benefit analysis of implementation.

Countermeasure recommendations for the Park and 4th intersection included installing "delayed green" signs on traffic lights to deter left-turn and rear-end crashes, reconstructing broken street lamps to reduce rear-end and right-angle crashes, and installing high-visibility pedestrian signals and crosswalks to allow for a smoother, safer walk for the community.

In total, the final report will feature the 20 medium- to high-risk safety concerns found by the RSA team. Once Essex County determines the feasibility to implement each of the cost-efficient countermeasures, a post-evaluation data analysis can be performed to determine crash reduction and overall improved quality of life for Newark residents. ■



UTCs show off their wares

Universities demonstrate the value of research at USDOT headquarters

On April 6, CAIT participated in the first University Research Technology Transfer Day, a one-day demonstration and exhibition of prominent university transportation products. Bringing "the show" to USDOT headquarters in Washington, DC, researchers from 25 universities plus the Federal Highway Administration and the Federal Aviation Administration delivered compelling evidence of the high-impact research made possible by the University Transportation Centers (UTC) program, which is administered by the USDOT Research and Innovative Technology Administration (RITA).

Amidst drafting of the new surface transportation bill—which will very likely affect funding for UTCs—it is important to highlight the positive impact of university-based research products that are used every day to make our transportation systems safer, more efficient, more durable, and more sustainable.

First discussed at this year's TRB annual meeting, the idea for the showcase quickly grew legs. Solicitation for the abstracts went out on January 31 with a deadline just 16 days later. Following a rigorous double-blind review, 27 projects were selected for presentation to USDOT administrators and employees.

CAIT proudly exhibited its Plan4Safety software at the prestigious event. Plan4Safety is a web-based application that allows safety professionals to gather, organize, filter, analyze, and map crash data to improve road safety through enhanced, data-driven decision making. Coordination between NJDOT and the Plan4Safety team has yielded a unique vision for the future of transportation safety in the state. By making this powerful tool available for free to all public agency professionals—and encouraging them to use it through support and training—this DOT-supported product has significantly raised the autonomous capabilities of the state's safety professionals at all levels. ■

Above: TSRC team members (left to right) Amir Rezvani, Mitra Fetrat, and Evan Bosset presented Plan4Safety at the USDOT showcase.

Encouraging imagination and ambition

CAIT staff "pay it forward" with hands-on guidance and outreach

Engineers mentor youth in the Future City competition

What would a city look like if a seventh or eighth grader designed it? That's exactly what engineers and teachers aim to find out in the annual New Jersey Regional Future City Competition, sponsored by the American Society of Civil Engineers. This year's competition was held on January 15 at Rutgers.

More than 70 student teams representing approximately 30 schools in New Jersey began planning their cities at the beginning of the school year. The culmination of their efforts was unveiled in a one-day competition to decide which student group designed the best city of the future.

Student teams are required to conceptualize their city in an explicit and technical way. Each group must prepare a computer-simulated model (using SimCity software), a written essay explaining their concept and approach, and a model constructed to scale. Through the exercise, students research and learn about city planning, community development, public transportation, public works, and other infrastructure systems.

As student teams begin their research and planning, they are paired with working professional engineers who provide guidance and insight throughout the development of the project. On the day of the competition, other volunteer engineers serve as judges, reviewing the models that the resourceful students construct from wood, tissue-paper tubes, and other materials. Entries are evaluated on the students' ability to successfully grasp basic concepts of city planning and expand their ideas of future technologies to help society.

For three years, Andrés Roda, P.E., from CAIT's New Jersey Local Technical Assistance Program (NJ LTAP), has worked as a volunteer mentor. This year, he was paired with Keyport Central School seventh graders on their city, "Endurance." The Keyport team focused on the effects diabetes had on their city and specifically on developing a mobile technology to assist community members afflicted by the disease.

Roda provided insight on a number of engineering applications including bridge building, sanitary and storm sewer systems, drinking water, power supply, telecommunications, building and zoning practices, as well as many other elements that go into the complex urban systems. Said Roda, "The students' interest in all these topics was piqued, and they were absolutely resolved to be truly innovative with their ideas. It made my job of mentoring easy. I was really proud of my team. I get a great deal of satisfaction in knowing I'm guiding these young people who will shape the future of our society."

Illuminating opportunities for Newark high school students

The Newark public school system offers a wide range of career and technical educational programs including tracks in print production, graphic design, and illustration. In these programs students learn design and

Opposite page: Andrés Roda, P.E. (center), research project manager at NJ LTAP, works with seventh-graders Emily Morgan (left) and Brenda Ferrer (right), members of the Future City Competition team from Keyport Central School.

production skills related to media, entertainment, publications, and advertising. Each year, juniors and seniors have the opportunity to have their work critiqued one-on-one with working professionals in a portfolio review session organized by East Side High School graphics teacher Denise Wiseman Michaels.

On May 13, Allison Thomas, CAIT creative director, offered guidance to these communications up-and-comers. "These kids might dream of a job in the recording industry or a swanky ad agency on Madison Avenue, but the reality—especially in this economy—is that those jobs are few and far between, and almost none of them are entry level," says Thomas. "I try to get them to realize they can make a good living and their talents are needed in places that never occurred to them. I'm a prime example of that—I'd have never guessed I'd end up in engineering research! I make the point that good communicators are needed even more in businesses where marketing may not be recognized as a top priority. Fact is, every organization needs to promote itself in one way or another and get the word out about the good work they are doing. I try to get the kids to think outside the box a little."

Around 60 students brought their design and illustration to the Marion A. Bolden Student Center for the morning review. Thomas then visited East Side High School for a more in-depth conversation with the students regarding her career at Rutgers and what they might expect when they begin their own rewarding journeys.

Another Successful Rutgers Day

Rutgers opened its doors to the general public on April 30 for the third annual Rutgers Day—an open house during which everyone from babies in strollers to grandparents on walkers can come learn about the huge range of academic and research activities at their state university.

CAIT sponsors activities that showcase the center's work in traffic safety, bridge engineering and condition monitoring, nondestructive evaluation technologies, pavement design and testing, advanced materials development, and more.

Rutgers Day draws around 75,000 visitors each year to the campuses in New Brunswick and Piscataway. The next Rutgers Day is scheduled for April 28, 2012. ■

The K'Nex bridge-building activity CAIT uses to teach youngsters the basics of structural engineering is always a big draw at Rutgers Day.

>> transportation today

Transportation Today is published by the Center for Advanced Infrastructure and Transportation (CAIT) at Rutgers, The State University of New Jersey.

Original photography
Cover and all images for International Bridge story, plus photo on page 11, by Drew Noel Photography, ©2010/2011.

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CAIT is a University Transportation Center supported by the Research and Innovative Technology Administration (RITA) at the U.S. Department of Transportation.

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kudos

CAIT engineer shares knowledge at minority conference

Andrés Roda, P.E., engineering research project manager at CAIT, moderated the panel "Is America really crumbling? What is being done about it?" at the 34th Annual Conference of the American Association of Blacks in Energy (AABE), April 27–29.

Roda, a director of the American Society of Civil Engineers (ASCE) New Jersey section, was invited because of his extensive knowledge of the ASCE Report Card for America's Infrastructure and his broad engineering expertise. Dan McNichol, author of *The Roads that Built America* and two books on Boston's Big Dig, and Larry Sutton, account manager for Southern California Edison, also were on the panel.

The AABE conference is a national forum to discuss the latest information and technology, critical issues, and challenges/opportunities facing energy executives and consumers. The conference drew approximately 400 members from AABE chapters nationwide, as well as government officials, regulators, academicians, corporate executives, and other professionals in the energy field. AABE is a nonprofit that is dedicated to ensuring that minorities are active in discussion and development of energy policies, regulations, R&D, entrepreneurial activities, and environmental issues. Members include professionals from the petroleum and utility industries, energy-related government agencies, colleges, universities, and entrepreneurial energy businesses.

CAIT UTC Student of the Year

Kristen Derewicki was named CAIT's University Transportation Center (UTC) Outstanding Student of the Year in recognition of her exceptional academic performance, the technical merit of her research topic, and her service to the university community. She received her award at the UTC awards banquet held at the 2011 TRB Annual Meeting in Washington, DC, in January. Derewicki is a master's of science candidate at Rutgers' School of Engineering. Her graduate thesis is on developing specifications and methods for performance grading asphalt binders with particulate matter.

She is currently researching the use of alternate geometries for determining the rheological properties of asphalt binder blended with crumb rubber. Her main objective from the research is to be able to update the test specifications for alternate geometries as an acceptable means to PG grade particulate bitumen. The use of crumb rubber within bitumen not only will save money by reducing the necessary asphalt content, but it also has the potential to create quieter, more sustainable roads.

Dr. Nenad Gucunski (left) is a widely respected expert in NDE technologies and regularly presents on the subject at professional conferences. He is pictured here explaining GPR to Congressman Jim Oberstar (center) with Michaela Anderson, a former member of the CAIT NDE team.

CAIT NDE experts go to SPIE conference

Nenad Gucunski, Ph.D., principal investigator for the Automated Nondestructive Evaluation and Rehabilitation System (ANDERS) program at CAIT, was invited to present, along with Husam Najm, Ph.D., and other joint members of the ANDERS team, at the SPIE Smart Structures/NDE Conference in March 2011. The conference is a multidisciplinary forum that advances research in adaptive structures and mechanisms, smart sensors, nondestructive evaluation (NDE), and other civil infrastructure systems.

Gucunski's presentation addressed areas of infrastructure concern for bridge decks, which are prone to various deteriorations. He presented current research from the ANDERS program in advanced NDE methods, such as ground-penetrating radar (GPR), impact-echo, and ultrasonics with a multi-sensor data fusion approach to process, integrate, and interpret the data in a way that offsets the respective limitations of each individual technology and improves the accuracy and reliability of deterioration identification and characterization for bridge decks.

In total there were seven papers presented at SPIE by the joint-venture members of the ANDERS program at CAIT (cait.rutgers.edu/anders). Research efforts at CAIT in programs such as ANDERS will help to form the foundation for a fundamental change in infrastructure asset evaluation and rehabilitation and encourage a paradigm shift in the way transportation infrastructure is assessed.

CAIT communications win again

Transportation Today was recently recognized with two awards. It was selected from more than 4,000 entries for the *Graphic Design USA (GDUSA)* American Inhouse Design Award, a national competition for designers working in inhouse communications departments. It also won a bronze medal from the Art Directors Club of New Jersey (ADCNJ) in their annual competition, which is open to ad agencies, design firms, and inhouse publications departments at corporate, nonprofit, and educational organizations statewide.

Also in the ADCNJ competition, the Rutgers Asphalt Paving Conference promotional package received a bronze medal, and a series of posters designed to inform visitors in the CAIT building about our programs was also selected for publication in the *GDUSA American Inhouse Design Annual*. ■


Center for Advanced Infrastructure and Transportation

RUTGERS

transportation today

>> What's black and yellow and rolled all over?

Next time you drive on roads in the tristate area, say "thanks" to CAIT's pavement lab

inside

On the outskirts of Rutgers' Livingston Campus is a row of barracks, remnants of the WWII-era Camp Kilmer that look every bit their age. Among these is the asphalt lab of CAIT's Pavement Resource Program (PRP): a facility that may very well have more to do with the roads we drive on every day than any other place in the region.

upcoming events

7th Annual New Jersey Safety Forum

The Annual New Jersey Safety Forum, hosted and organized by CAIT's Transportation Safety Resource Center (TSRC), will be held on October 19, at Mercer County College.

In the past few years, implementing safety initiatives has become more challenging, especially in this economic climate. This year, the Safety Forum will take a multidisciplinary look at designing roads, enforcing laws, and educating drivers through a budget-wise approach. The forum also will identify how counties and municipalities can gain access to state and federal safety funds. This year, the Safety Forum welcomes nonprofit and private vendor booth exhibits.

More on the web: Agenda and registration information at cait.rutgers.edu/tsrc/safety-forum-2011

2nd Maritime Risk Symposium

The Maritime Risk Symposium will be held November 7–9 at Rutgers. CAIT and the Command, Control and Interoperability Center for Advanced Data Analysis (CCICADA) have partnered with the U.S. Coast Guard Area Commands to host this symposium focusing on risk and economic assessment and risk management methodologies applicable in the maritime domain. The theme of the symposium is Developing Public-Private Partnerships in Homeland Security: How Risk Impacts Government Policy and Business Requirements. Presentations, lectures, and expert panel discussions will address topics such as maritime risk assessment and policy making from government and industrial perspectives, the impact of risk mitigation on business requirements, international perspectives, and the role of intelligence.

This will be an excellent platform for academic, industry, and government partners to discuss joint approaches for risk and policy issues together.

More on the web: cait.rutgers.edu/maritime-risk-2011 ■

addendum

We apologize for the following omissions in our last issue:

Nick Vitillo, Ph.D., research associate with CAIT's Pavement Resource Program (PRP), presented at the third Upper Midwest Transportation Materials Summit at Michigan Tech in November 2010. Vitillo gave a summary of New Jersey's approach to implementing processes of the Mechanistic Empirical Pavement Design Guide (MEPDG), summarizing work done on material characterization, training and education, seasonal variation, and the cooperative interaction between NJDOT and PRP. Since Michigan is in the beginning stages of this effort, New Jersey's experience was seen as a valuable blueprint to help MDOT implement the MEPDG in their state.

On page 4 of our January 2011 issue, we failed to credit the photo of OGFC lanes compared to traditional pavement to **Wayne Byard of Traprock Industries.** We thank Mr. Byard for capturing the dramatic side-by-side comparison illustrating splash and spray reduction properties of OGFCs. ■

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