Superstorm Sandy made landfall on the New Jersey coast October 29, 2012, bringing hurricane-force winds and a storm surge of unimaginable power. At nearly 1,000 miles wide, it was the largest Atlantic storm ever and the second most costly, deadly, and destructive weather event in U.S. history, topped only by Hurricane Katrina in 2005.

All told, Sandy caused about $60 billion in damage to the region. The East Coast has seen hurricanes before, but the astonishing size and intensity of this storm, coupled with the region’s dense population and intricate infrastructure, caused inconceivable devastation.

Infrastructure systems—especially power and transit—were inundated and largely destroyed. (See director’s message, page 2.) Iconic beaches and boardwalks at the Jersey Shore were washed away, homes blew or floated off their foundations, and roadways were reduced to sparsely scattered broken slabs of asphalt.

The majority of catastrophic damage occurred within 50 miles of Rutgers, putting university researchers in a unique position to study the disastrous effects of major storms.

That’s why Rutgers is seizing the opportunity to help communities prepare for, respond to, and recover from extreme weather events.

A silver lining to Sandy’s dark cloud is the extraordinary cooperative effort to learn from
One storm, many lessons

It’s been six months since Superstorm Sandy’s fierce winds ripped through the Eastern Seaboard bringing the most drastic storm surge the region has ever seen.

When the floodwaters receded and lights came back on, officials assessed Sandy’s damage at $60 billion or more. The blow to infrastructure can only be described as catastrophic, and most of the carnage was within 50 miles or less of Rutgers campuses in southern, northern, and central New Jersey.

Within 10 days of the storm, most of the power grid was back on, but life without electricity dragged on for months in some areas. In New Jersey alone, more than 2,200 electrical transformers and 5,600 utility poles were damaged or destroyed. Power restoration took a Herculean effort. Over 12,000 utility workers came in convoys from Texas, Florida, and 26 other states. The military even airlifted support—in one case, 75 trucks and 200 workers from Southern California—and crews worked 24/7.

All along the Jersey Shore, all that remained of many streets was strewn chunks of pavement; streets that were in tact, were covered with tons of sand and debris. Buildings were knocked off their foundations or entirely blown away. A now-iconic aerial photo of the ocean breach at the Mantoloking Bridge is representative of the destruction to roads and bridges.

Transit systems were inundated. Tracks dislodged, bridges and ballasts washed away, and boats were tossed onto the rails. NJ Transit estimates the cost of the storm at $450 million. Several hundred million gallons of water had to be pumped out of the New York City Subway before the MTA could even begin to address the entirely “fried” electrical system.

As my message stated in the last issue of Transportation Today, the recovery will be long. There is some debate about where efforts should be concentrated, but everyone agrees that what we rebuild has to be stronger, better, and smarter.

Rutgers is in a unique position—geographically and intellectually—to help analyze Sandy, respond to immediate needs of transportation agencies in the metro area, and investigate ways to fortify critical infrastructure and make it more resilient, not just in New Jersey and New York, but all along the I-95 corridor—the most complex and heavily traveled multimodal transportation network in the country.

This is an unprecedented opportunity for engineers, scientists, architects, policymakers, and planners to make real and lasting contributions to help us weather the severe storms that will inevitably challenge us in the future.

In this issue of Transportation Today, you will read about the many ways CAIT and all its partners are collaborating to address these challenges and support recovery efforts, as well as state of good repair across the country.

Ali Maher, Ph.D., Director
While these issues are fresh in the minds of decision makers and the general public, it’s hard to imagine a more opportune time to examine engineering, environmental, and planning perspectives of storm mitigation and infrastructure resiliency, and to reconsider, update, and strengthen strategies for dealing with nature’s violent side.

**Before the bulldozers roll: Using laser technology to gather key data**

Quickly starting to rebuild is important to the healing process; however, once the debris is swept away, so is invaluable information on how different types of infrastructure withstand severe weather conditions.

CAIT-backed Rutgers civil engineering professor Dr. Jie Gong teamed up with Woolpert, Inc., to assess the storm damage on buildings, roadways, and utilities in devastated coastal communities of New York and New Jersey using mobile Light Detection and Ranging (LiDAR) technology.

The mobile LiDAR system consists of a vehicle-mounted laser scanner similar to a camera. However, unlike conventional photography, LiDAR instantaneously scans and collects millions of spatially accurate data points and measurements to create precise, three-dimensional images—in other words, a virtual reality. As the vehicle moves, the laser scanner “bounces” information back to a computer, where it marries image data with position data collected simultaneously via GPS.

The LiDAR team scanned roughly 80 miles of storm-ravaged neighborhoods, including Seaside Heights and Mantoloking, New Jersey, and selected areas of Staten Island and the Rockaway Beach section of Queens, New York.

Data collected from the CAIT study create a permanent archive so researchers like Gong can analyze the specific effects of heavy winds, strong waves, and flooding on infrastructure, even long after the event. These analyses will be especially beneficial to USDOT, the Federal Emergency Management Agency (FEMA), and city and state governments for post-storm evaluation and reconstruction of transportation and other systems.

“[Mobile LiDAR] establishes a high-resolution and accurate baseline of existing communities for disaster preparation,” Gong says. “Archiving the 3D images provides a record for officials to reference during and after future disasters.”

Understanding which types of structures sustained damage—and which ones survived—can help officials implement more efficient demolition, recycling, and reconstruction, but Gong believes mobile LiDAR can revolutionize recovery efforts in another way. The technology’s fast and accurate data collection not only produces highly detailed images, it also expedites the rebuilding process itself.

In the past, traditional assessments consisted of preliminary damage evaluation, followed by reconstruction surveying. With mobile LiDAR, disaster assessment can be sped up because while the system produces 3D condition data, it concurrently uses a survey-grade mapping system. With data extraction, the team can produce survey drawings, cutting in half the time it would usually take to assess and prepare to rebuild hard-hit areas.

The technology also can be valuable in other ways. Gong is working on another project with the Illinois Department of Transportation to determine road crash ratings using mobile LiDAR. Those findings will help decision makers implement data-driven safety improvements to keep highways and roadways running at peak efficiency.

The first week of April, CAIT was notified that the mobile LiDAR project received a 2013 Distinguished Engineering Award from the New Jersey Alliance for Action, an influential...
nonprofit, nonpartisan coalition of labor, professional, academic, and government leaders. They honor engineering projects each year that advance their mission to advocate for investment in infrastructure and promote capital construction and economic growth opportunities for New Jersey and the surrounding region. Is mobile LiDAR the future of condition assessment and research? Gong thinks so, but not without limitations.

“As with any evolving technology, large volumes of data and lack of automated post-processing tools present a roadblock to widespread adoption,” Gong says. “CAIT’s mission to maintain a state of good repair goes beyond those limitations; the data gathered from the study will have much more influence on the long-ranging health of our infrastructure than any disaster ever will.”

In the meantime however, LiDAR-produced 3D output will help officials in storm-ravaged areas develop better response strategies and prepare the infrastructure we rely on to withstand brutal storms like Sandy.

Remapping risk: Hazard assessment and flood mitigation

Experts at the Bloustein School, along with other units at Rutgers, have been working with the FEMA and the New Jersey Office of Emergency Management (NJOEM) for several years now, examining how land use, protective infrastructure, public attitudes and awareness, and other factors influence flood impacts. Dr. Henry Mayer, executive director of the Bloustein School’s Environmental Analysis and Communications Group, is managing the research project.

Predicting the effects of extreme weather and the probability for success or failure of various mitigation actions is a daunting, complex undertaking. In the past, much of it was done without the advantage of cutting-edge data analysis, simulation, or modeling tools.

Given the grave personal and economic losses caused by hurricanes and other severe storms, government officials and property owners need tools to help them quantify risks; identify planning, land use, construction, and protective strategies to minimize damage; and formulate effective preparedness, response, and recovery plans.

The main components of the FEMA flood mitigation and modeling project CAIT is assisting with are 1) mapping of flood insurance and other payouts caused by major storms over the past 15 years, and identifying those communities and neighborhoods that have been most impacted, 2) cost/benefit analysis of various mitigation strategies that might be used to reduce flooding and resulting damages, and 3) discussing these results with local stakeholders to determine what may be preventing their implementation and how these issues might best be addressed.

There are currently three phases to the FEMA project; plans include a fourth phase, which is expected to commence soon.

Phase I began when, following a powerful nor’easter that ravaged the area with high winds and torrential rain in March 2010, FEMA asked researchers at the Bloustein School to examine flood risks and costs in the Raritan River Basin.

Then, after Hurricane Irene in August 2011, the project scope expanded to also include the Passaic River watershed in northern New Jersey, which sustained damage equal to or worse than communities to the south. Thus began Phase II.
New Jersey’s beach boardwalks are as much a symbol of the state as the Turnpike, Bruce Springsteen, and tomatoes. You probably have seen pictures of miles of boardwalks all along the Atlantic coast damaged by Superstorm Sandy. The one in Belmar, New Jersey, wasn’t just damaged; it was obliterated.

Governor Chris Christie has vowed to rebuild beaches, roads, and boardwalks by the summer tourist season for both emotional and financial reasons. While there is some debate about where efforts should be directed, everyone agrees that what we rebuild has to be stronger and better than it was.

Construction is going on all over the state that hopefully won’t happen again for decades, so it’s a truly unique time for civil engineering students to “watch and learn.”

That’s why Kathy Elliott, senior associate and principal engineer for Birdsall Services Group (BSG), and CAIT research project manager Brian Tobin, put together a field trip for Rutgers’ Chi Epsilon civil engineering honor society to see exactly what’s involved in reconstructing the boardwalks that millions of shore-goers stroll along every summer, having too much fun to think of the time, money, and hard work that built it.

On February 15, a group of 17 civil engineering undergraduates traveled to Belmar, where BSG is overseeing reconstruction of 1.3 miles of boardwalk. BSG and Epic Management, Inc., the general contractor, are committed to completing the project in time for Memorial Day weekend, the traditional kickoff of the summer shore season.

One thing that helped fast track the project is that the new walkway is being reconstructed directly over the footprint of the old boardwalk. This avoided sometimes-lengthy environmental permitting (since no additional surfacing or structures would be built) and also prevented the loss of any additional sunbathing “real estate” on the beach, which is now an average of 30 to 40 feet narrower than before the storm. (In some areas, as much as 125 feet of beach was lost to Sandy.)

But footprint and appearance are just about the only similarities between the old and new boardwalks.

Subcontractor Linde-Griffith Construction Co. is driving the new piles that will anchor the deck 22 feet into the sand, as opposed to the mere six to eight feet of the previous boardwalk. They are sinking 75 to 110 piles a day until all 3,000-plus are in place.

Above: CAIT took a group of 17 civil engineering students to Belmar, New Jersey, where Birdsall Services Group is overseeing reconstruction of 1.3 miles of boardwalk that was destroyed by Superstorm Sandy. Photo ©2013 Brian Tobin

A day at the beach
CAIT and BSG show students Jersey Shore boardwalk reconstruction

New Jersey’s beach boardwalks are as much a symbol of the state as the Turnpike, Bruce Springsteen, and tomatoes. You probably have seen pictures of miles of boardwalks all along the Atlantic coast damaged by Superstorm Sandy. The one in Belmar, New Jersey, wasn’t just damaged; it was obliterated.
“The pounding was pretty intense,” said Bill Thompson, president of the Rutgers’ Chi Epsilon chapter, as a huge pile driver repeatedly slammed one of the giant posts deep into the sand. “Feeling the ground move from the impact is something I won’t forget,” he said.

But resident Francina Walton, who lives just two blocks away, was quoted in the newspaper saying, “[It’s] a good sound. It’s progress. It’s bringing us back.”

Once the pilings are driven and joists are laid, hurricane straps are attached to each joist to ensure the structure withstands future storms, even if they’re as strong as Sandy. On top of the joists goes the decking, laid in an attractive herringbone pattern: boards running the length of the walkway in the center, flanked by a chevron of angled boards. Each board is fitted in place by hand, nailed, planed, and trimmed. A simpler pattern might have been faster or easier, but decision makers agreed they wanted the new boardwalk to look like the one that was there before it.

The decking boards are Trex Transcend, a synthetic material more durable than most wood. Trex mimics wood’s grain and appearance, so it won’t look drastically different than the old boardwalk. The material will not only last longer than wood, it also is very low maintenance, which translates into less time, money, and labor for the borough’s public works department.

Even Tobin, who has years of experience in the construction industry, learned a few things. “I didn’t realize how much of the work is done by hand,” said Tobin. “It’s amazing they do this for every one of the thousands boards that will make up the boardwalk.”

It was obvious the students were captivated too. “I couldn’t believe the number of pilings that had to be installed; you couldn’t see from one end to the other. Being here while the boardwalk is being ‘resurrected’ is a rare experience I’m very grateful for,” Thompson said.

Elliott was happy to show the students the important and exciting work they might do when they become full-fledged civil engineers. “Several years ago I taught a construction management course at Rutgers as an adjunct professor, so I knew getting the students onto an active construction site would give more meaning to their classroom lectures,” said Elliott. “The students had so many questions; it proved they were really engaged. I’m confident the site visit gave them a better appreciation of what really goes into designing, constructing, and managing a multi-million dollar project.”

“I’ve lived in the Belmar area for over 14 years and have run hundreds of miles on the boardwalks from Spring Lake to Asbury Park,” Elliott added. “Being a part of the reconstruction helps me give back to a community that was absolutely devastated by Superstorm Sandy.”

The thump of the pile drivers and buzzing of power tools should quiet down before the the end of May, when the Belmar boardwalk will be brought back to life.

Chi Epsilon students got a once-in-a-lifetime chance to observe reconstruction of the Belmar boardwalk. Left to right standing: Robert Bye (Epic Management), Kathy Elliott (Birdsall Services Group), Bill Thompson, Victor Baquero, Lucas Jaramillo, Brian Deitz, Anthony Marrero, Neel Patel, Brendan Roddy, Juan Alfonso, Namit Nagpal, Binal Rana, Rucht Patel, Sapan Shah, and Daniel Septon. Front row: Pedro Sabillon, Ryan John Ramones, and Martin Rafla. Photo ©2013 Lucas A. Jaramillo
Collaboration sparks effective solutions
CAIT-UTC consortium does its part in achieving state of good repair

Solutions to complex problems never form in a vacuum. The intricate challenges we face to keep U.S. infrastructure performing soundly will only be solved through meaningful teamwork. Everyone has a stake in state of good repair—and everyone has to work together to achieve it.

In CAIT’s 15 years as a University Transportation Center (UTC), we’ve seen time and again that the most significant progress evolves from the input, ideas, and perspectives of multiple participants; the CAIT-UTC consortium cultivates the kind of teamwork that leads to discovery.

Tapping researchers’ collective wealth of knowledge and establishing a national network of laboratories has obvious benefits. Together, the consortium’s nine distinguished universities are able to expand research, education, workforce development, and technology transfer activities beyond what any one institution could possibly achieve alone.

In its first year, the CAIT-UTC Consortium coalesced and has already made significant strides to contribute to reaching the USDOT goal to maintain and improve U.S. infrastructure.

In addition to building each partner’s research portfolio with individual projects, the consortium has established a collaborative pool-fund program that fosters substantial and effective partnerships and gives members the support they need to pursue innovative solutions for state-of-good-repair issues.

To be funded, collaborative pool projects must involve a minimum of two partner institutions.

In September 2012, CAIT hosted a partner meeting to brainstorm research projects and ways the consortium can leverage resources and assets.

A distinct advantage of the consortium is that each institution brings valuable information about their various stakeholders’ most pressing issues. Such relationships help us “keep a finger on the pulse” of the transportation community, ensuring we have direct knowledge about the needs of our customers.

Overarching topics at the partner meeting were innovation, validation, and implementation. In the 21st century, integrating research and technology deployment can’t be an afterthought. Many discussions that day focused on creating products and technologies that can be quickly validated and implemented in the field.

Part of the afternoon was dedicated to four breakout sessions to explore potential research projects and a range of possible approaches. The four sessions focused on bridges/structural health monitoring, pavements, asset management, and freight/port.
operations. During these focused discussions, the seeds for nationally significant research began to germinate.

One of the selected collaborative projects, “Numerical Simulation of Intelligent Compaction Technology for Construction Quality Control,” stemmed from a discussion on the FHWA Every Day Counts 2 (EDC2) initiative. Consortium member University of Texas at El Paso (UETP) saw the opportunity to leverage this UTC-funded research with related work being done by Texas DOT. Joining efforts meant that even more could be learned about intelligent compaction.

Another project, “Biomaterial Applications for Flexible Pavements,” emerged from the pavements session. For this work, Rutgers, University of Delaware, and UTEP will share resources, increasing efficiency and economy.

These are just a two examples of the research projects that came out of the partners meeting. A list of the new collaborative projects underway is below, and base-funded projects are listed in the table on the opposite page. Working together will lead to innovative, widely applicable solutions. We believe we are well on our way to the next big breakthrough in state of good repair.

**Analysis of Interactions between the Marine Terminal and Highway Operations**
Rutgers (lead) and NJIT
Develop a simulation model that is capable of ascertaining the interactions between marine terminal operations and the highway system that provides access to the port. Also, define a set of operational and policy improvements to address the deficiencies of the highway system in handling growing port-related truck traffic.

**Analyzing Asset Management Data Using Data and Text Mining**
Rutgers (lead) and Utah State University
Produce useful models for identifying infrastructure deficiencies and providing better management information to decision makers tasked with keeping infrastructure assets in a state of good repair. In addition, examine how data mining can be used to reduce costs by more quickly identifying problems, before more expensive interventions are needed.

**Biomaterial Applications for Flexible Pavements**
Rutgers (lead), Princeton, University of Delaware, and University of Texas at El Paso
Investigate incorporation of biomaterials for two aspects of pavement design: 1) In binders: Examine the use of biomaterials to modify asphalt binders or as a substitute for petroleum-based asphalt binders. Certain biomaterials have been shown to act as antioxidants and may be a viable substitute for petroleum. Antioxidant properties may delay onset of cracking in asphalt binders, whereas use as a substitute for petroleum could reduce U.S. dependence on foreign oil. 2) In unbound base or sub-base materials: Evaluate potential microbial activity to stabilize subgrade liquefiable soils and develop a methodology for mixing of soil and bacterium that is most suitable for soil stabilization.

**Feasibility of Bridge Structural Health Monitoring Using Short-Term Data Acquisition System**
Utah State University (lead), Columbia, and Virginia Tech
Develop a self-contained, structural health monitoring system that tracks critical bridge behavior over a period of four to six weeks that will serve as a useful tool for making decisions related to bridge maintenance or replacement.

**Multi-Sensor Sheets Based on Large-Area Electronics for Advanced Structural Health Monitoring of Civil Infrastructure**
Princeton (lead), Columbia, and University of Delaware
Develop and evaluate a prototype of a novel multi-sensor sheet that is inexpensive, can be equipped with a variety of different sensors, is easy to fabricate and deploy, and provides densely spaced quantitative measurements from large areas of a structure. These sensing sheets will not be structure-specific, so they can be used to assess a large variety of structures composed of different materials (bridges, pipelines, tunnels, wind turbines, etc.). This multi-sensing approach and tool also could be applied to study damage initiation and propagation.

**Numerical Simulation of Intelligent Compaction (IC) Technology for Construction Quality Control**
University of Texas at El Paso (lead) and Rutgers
Better understand the process of accepting compacted materials to ensure quality, performance, and durability using IC technology. Develop innovative numerical models to document and understand the theoretical limitations and sensitivities of this technology in order to generate more rigorous specifications.
The CAIT-UTC consortium’s national network of laboratories pursues USDOT’s state of good repair (SGR) strategic goal. Each partner in the consortium has proficiencies in important elements of SGR: advanced infrastructure condition monitoring, asset management, advanced/innovative materials and devices, and construction management and innovation. This graphic illustrates each partner’s strengths in these areas as well as the geographic diversity of the consortium.
One tangible example is the first State of Good Repair Summit, a national platform for information exchange and discussion. The CAIT consortium and its supporting partner for the event, the American Society of Civil Engineers (ASCE)-New Jersey Section, hosted over 100 transportation professionals from government, industry, and academia on March 27.

CAIT Director Dr. Ali Maher welcomed attendees with an overview of the USDOT state of good repair mission and set the stage for rest of the day. “The key to maintaining infrastructure health,” Maher said, “is asset management, especially in the Northeast and mid-Atlantic regions where aging systems and heavy volume are constant factors.”

Speakers from Delaware, New Jersey, New York, Pennsylvania, and Virginia followed Maher, exploring how maintaining infrastructure health is almost impossible without asset management.

President and CEO of Pennoni Associates, Anthony Bartolomeo, P.E., provided an update on the new ASCE Infrastructure Report Card and stressed the consequences of not taking action on its warnings.

Steven Hanson, an FHWA Transportation Specialist, and David Kuhn, NJDOT assistant commissioner, outlined the fiscal responsibility of public and private agencies.

Colonel Stephanie Dawson, acting chief operating officer of the Port Authority of New York and New Jersey (PANYNJ), which operates the largest cargo port on the East Coast, spoke on how using solid asset management in port facilities is important for the economic vitality of the maritime sector and the country.

Jeff Knueppel of the Southeastern Pennsylvania Transit Authority (SEPTA), a node of Philadelphia’s public transportation system that carries around 340 million riders annually, followed with his views on transit asset management and how it can improve safety, community, and quality of life.
Senior vice president of Fluor Enterprises, Inc., Bob Prieto, outlined impediments—like lack of funding or data, and social and environmental pressures—that may stand in the way of asset management adoption.

Dr. Sue McNeil, a professor and licensed professional engineer from consortium partner University of Delaware, outlined scenarios in which proper asset management practices can actually “save” a structure.

Next, Drexel University professor, recognized bridge expert, and frequent CAIT collaborator Dr. Franklin Moon and CAIT senior research fellow Dr. Nicholas Vitillo introduced data collection and examination using nondestructive evaluation (NDE) and other monitoring methods that can “see inside” roads and bridges to reveal developing flaws before they can be detected visually. “A good pavement management system can tell a road owner current conditions, set a timeframe for achieving the desired ‘state of good repair’ level, and determine the funds necessary to achieve that level,” Vitillo said.

Dr. Gerardo Flintsch, director of the Center for Sustainable Transportation Infrastructure of Virginia Tech Transportation Institute, explored infrastructure health assessment and monitoring with specific practices—like accessing quality data, NDE, and 3D modeling—that can be employed to improve performance.

William Vavrik, vice president and principal engineer of Applied Research Associates, discussed various tools and resources to manage assets, and infrastructure condition monitoring and NDE expert Dr. Nenad Gucunski expanded on many solutions that examine structures without degrading them.

To close the conference, Dr. Jie Gong—a civil engineering assistant professor and one of CAIT’s newest affiliated faculty members—joined Gucunski for a discussion forecasting asset management trends and the role of quantitative data in rehabilitation, maintenance, and research. “Our infrastructure is our responsibility,” Gong said. “When we advance technology, we advance the state of good repair mission.”

Traveling lecture series provides ongoing dialog about SGR

After its inaugural season last year, the CAIT-UTC State of Good Repair Traveling Lecture Series got off to a solid start in 2013 with two presentations from international experts.

**Risk-Informed Management of Bridge Infrastructure**

On February 7, consortium member Princeton University brought Dr. Daniel Zonta from the Department of Transportation of the Autonomous Province of Trento (APT), Italy, to speak on bridge management in his country. A structural health monitoring expert, Zonta explained how risk-based paradigms have been incorporated into the APT bridge management system. He presented case studies that can be easily applied in the United States, including inventory, condition, and cost collection, and how this information can dictate budget programming.

**Design Code Calibration for Concrete Structures**

On February 27, consortium member Virginia Tech invited Dr. Andy Nowak, a University of Nebraska engineering professor with over 30 years of teaching experience, to discuss how well-calibrated load and resistance factors are critical design procedures that impact long-term structural performance. Nowak presented his research findings on statistical parameter updates for reinforced concrete beams with lightweight, ordinary, and high-strength concrete. He also outlined new material test data that satisfies appropriate strength reduction factors for flexure and shear.

SGR webinars are typically held once a month; each time, a different consortium member hosts a presentation on hot topics such as advances in infrastructure condition monitoring, transportation systems design, and more.
Added to the mix are streams of buses and taxis, people rushing to and from the NJ Transit train station, Rutgers students heading downtown, and wailing ambulances en route to Robert Wood Johnson University Hospital less than a block away.

People on foot often jaywalk rushing to catch their train. Buses maneuver through crowded lanes and sharp angles. Without enough turnouts to handle the volume, taxis and other drivers block traffic as they pick up or drop off commuters from the train station.

It’s a confusing place for everyone involved—drivers, cyclists, and pedestrians—and congestion is chronic.

But Rutgers civil engineering assistant professor Dr. Eric Gonzales saw something in the clutter: an ideal opportunity to give his traffic engineering students a look into real-world applied research while improving safety for New Brunswick residents at the same time.

To help realize his vision, Gonzales applied for a Community-University Research Partnership Grant, a joint program of Rutgers’ Office of Community Affairs and the New Brunswick chancellor’s office that gives recipients up to $25,000 to do community-based research. Gonzales is one of 14 Rutgers professors to receive a 2012 grant.

Gonzales focuses his research on understanding how transportation systems relate to the cities they serve. For nearly a year, he has been working with City of New Brunswick traffic engineers, investigating ways to improve traffic flow and safety for everyone who shares the streets.

The project examined a total of seven intersections near the New Brunswick train station, all of which have layouts and traffic patterns that tend to confuse people whether they are driving, cycling, or walking. “Traffic studies have been very car-focused for a long time,” said Gonzales. “We looked closely at pedestrian behavior [too].”

With the help of his students, he analyzes traffic flow in detail and then proposes multiple scalable fixes that can range from minor adjustments in signal timing, signage, or road markings, all the way up to major reconfiguration.

At George and Somerset streets, for example, buses have to make wide swings into opposing traffic lanes to avoid sideswiping a railroad-bridge abutment. At Albany and George streets, three lanes of traffic on one
side of George Street become one lane on the other. Easton Avenue and Somerset Street cross each other at an angle, tempting pedestrians to seek shortcuts outside crosswalks.

The Federal Highway Administration (FHWA) recently designated New Jersey and six other states as “intersection focus states,” aiming to improve safety and functionality of roadway junctures. This federal initiative comes with a collection of new, improved treatments and techniques to help safety professionals address intersection issues, including many that Gonzales suggested to city engineers.

“The city is always concerned about the safety of its intersections,” said Gonzales, who partnered with New Brunswick city planner Glenn Patterson on the project. “Our objective was to identify countermeasures—interventions that reduce congestion and improve safety.”

Starting in the spring of 2012, Gonzales sent students to these intersections to collect data and make video recordings of pedestrian and vehicle traffic.

He also worked with CAIT, taking advantage of their expertise in municipal road safety audits (RSAs), which the center has been coordinating for about five years. Using Plan4Safety—the crash-data tool developed by CAIT’s Transportation Safety Resource Center (TSRC)—the team analyzed three years of data on vehicle and pedestrian incidents at these intersections to reveal trends.

County and state personnel were involved in the effort, since several of these city streets fall under their jurisdiction. In addition, Gonzales and Patterson sought perspectives from various stakeholders, including transit operators; ethnic groups, disabled people, and seniors; emergency responders; and the New Brunswick Parking Authority.

“New Brunswick is looking to make the city more walkable, and the area around the station has one of the highest pedestrian and vehicle volumes in the city,” said Patterson. “It also is the connection between the Rutgers campus and downtown. We want to make these streets comfortable for all users. The safety audit is helping us find ways to do this.”

Some issues they identified could be fixed inexpensively—for example, adding a more visible “no turn on red” sign at Easton Avenue and Somerset Street, retiming traffic and pedestrian signals at Easton Avenue and Albany Street, or installing clearer signs for passenger drop-off at the train station. Other improvements might require larger investments, such as new traffic lights at George and Somerset streets positioned so buses have more space to execute turns.

“We look for technical solutions [at these specific locations],” says Gonzales, “but on a more fundamental level, the traffic data from this study is useful for assessing our current methods of designing and operating urban intersections and traffic signals.”

Opposite page: Dr. Eric Gonzales and a bird’s-eye view of one intersection involved in his traffic study.

Photo ©2013 Rutgers/Nick Romanenko

Right top: Where Easton Avenue and Albany Street meet is a “perfect storm” intersection that has unusual geometry, medians/islands, visibility issues, staggered signals, and high-volume vehicular and foot traffic.

Image ©2013 Google

Right bottom: Gonzales (center) guides a group of students and government and community representatives on a road safety audit at Albany and George streets in downtown New Brunswick.

Photo ©2013 Rutgers/Nick Romanenko
In President Obama’s last State of the Union address, he reminded us that more than 25 percent of U.S. bridges need repair or replacement. Per lane mile, bridges are the most expensive and critical parts of the roadway network. Even a brief bridge closure causes a ripple effect on traffic that is felt for miles around. Bridges with problems need to be fixed—and fixed fast.

Several new methods to expedite bridge construction have emerged in recent years. Accelerated bridge construction (ABC) technologies are a top priority of the Every Day Counts 2 initiative, an FHWA program that encourages effective infrastructure management and innovative technologies to achieve a continuous state of good repair.

ABC makes bridge replacement more cost effective and shaves months off traditional construction schedules. And, by expediting construction, ABC methods also minimize congestion and improve safety for construction workers and motorists.

FHWA promotes three methods of ABC that incorporate specific materials and state-of-the-art techniques: prefabricated bridge elements and systems (PBES), geosynthetic-reinforced soil-integrated bridge system (GRS–IBS), and slide-in bridge construction. (See GRS-IBS sidebar on opposite page.)

Utah Department of Transportation (UDOT) is a national leader in ABC adoption with more than 100 PBES bridges in service. PBES bridges use prefabricated elements that are constructed offsite, then assembled at their designated locations.

With so many PBES bridges in close proximity, Dr. Paul Barr, a civil engineering professor at Utah State University (USU) and CAIT-UTC partner lead, offered to help his state assess structural performance of its ABC bridge inventory. He partnered with Bridge Diagnostics, Inc., which specializes in structural health monitoring.

It wasn’t long before an extraordinary test specimen became available. Due to highway rerouting, UDOT decommissioned the 8th North Bridge on I-15 in Salt Lake City (a PBES bridge) after only two years of service. This provided the USU team with a “living lab” to study precast bridge deck performance very early in a structure’s life cycle.

Prior to the bridge being taken out of service, the researchers first conducted
extensive field tests, looking at real-world loading conditions and simulated stressors on the bridge.

“This was an opportunity to see what we could learn about a particular connection detail used called shear pockets. We found loads caused the bridge deck to shift unevenly with respect to the girder near the bridge supports,” Barr said. “This phenomenon is called non-composite behavior, an instance where the elements of the bridge aren’t ‘working together’ as well as they could be.

“Conversely, the loading had little to no effect near the middle of the girder—the shear pockets, girder, and deck all behaved symbiotically—they displayed good composite behavior,” he explained.

After the bridge was taken out of service, Barr’s team did something very few researchers ever have a chance to do: They transported two full-scale bridge sections that included five of the PBES deck panels and four girders over 35 feet long to the USU Systems, Materials, and Structural Health (SMASH) Laboratory for forensic testing.

A “layered approach” to building better bridges

CAIT educates consultants and agencies on accelerated bridge construction

To combat the growing number of aging and deficient bridges in our country, FHWA’s Every Day Counts 2 initiative recommends three accelerated bridge construction (ABC) technologies that incorporate elements that are fabricated offshore, then transported and assembled into the final structure.

On February 28, CAIT hosted more than 50 agency officials and private consultants for an overview on one FHWA-approved ABC: geosynthetic reinforcement soil–integrated bridge system (GRS-IBS). GRS-IBS is typically used for smaller bridges found on municipal and county systems. Presented by FHWA geotechnical experts Daniel Alzamora, P.E., and Michael Adams—both seasoned project management and design professionals—the one-day seminar offered a technical view of GRS-IBS and its benefits.

The idea of using reinforced earth as structural support has been around for thousands of years; however, it wasn’t until the 1980s that geosynthetic reinforcement gained popularity in bridge construction. GRS-IBS uses a synthetic mesh combined with thin layers of coarse stone to form composite abutments to support prefabricated bridge deck elements.

“With this support system, precast decks can be put into place quickly, cutting the duration of costly detours and expensive labor,” Adams stated.

Alzamora and Adams explained that the technology has ride-quality benefits too. Conventional bridge abutments can cause transitional bumps at the ends of the span due to uneven settlement rates of the bridge and the roadway. GRS-IBS uses alternating layers of compacted granular fill and sheets of geotextile reinforcement to provide a smooth transition where the road and bridge meet, alleviating that “bump at the bridge.”

According to Alzamora and Adams, GRS-IBS construction also is much more adaptable than traditional methods: “Typically, you have site plans that catalog climate and soil conditions, traffic patterns, etc. We all know that when it comes down to building the bridge, sometimes unforeseeable obstacles emerge,” Alzamora said. “With GRS-IBS technology, design modifications are easier.”

Can GRS-IBS be feasibly integrated into standard bridge construction procedures? According to Alzamora and Adams, the answer is, absolutely yes.

“Ultimately, we want you to know that there are sustainable alternatives out there that will save time, money, and lives, and get bridges completed faster and performing better.”

Above: GRS-IBS bridge construction over Tiffin River in Defiance County, Ohio. Photo ©2009 Dr. Kimberly A. Warren, University of North Carolina at Charlotte
State of good repair requires a management strategy that addresses one over-arching question: How do we maintain optimal performance of a structure so it can continue to serve the needs of its users? Structural health monitoring (SHM) is part of the answer. SHM allows infrastructure managers to gather timely, quantitative data on various condition factors that helps them develop maintenance plans, manage costs, improve safety, and increase their overall understanding.

On March 22, UTC consortium member Princeton University hosted its fourth Short Course on Structural Health Monitoring Using Fiber Optic Sensors, to educate engineers, researchers, consultants, contractors, and infrastructure managers and owners on the benefits of fiber optic sensing (FOS) technologies and how this valuable tool can be incorporated into their monitoring activities.

Presented by Princeton civil and environmental engineering professor Dr. Branko Glisic, the one-day course began with an overview of SHM, including best practices and case scenarios in condition assessment protocol. Presentations covered benefits and financial aspects of well-managed SHM, FOS implementation, how to interpret sensor measurements, and case studies from around the world.

By analyzing optical signals within the fibers, FOS sensors assess a range of parameters including strain, temperature, tilt, and deformation. Plus, unlike traditional monitoring devices, FOS sensors are not as vulnerable to environmental factors like electromagnetic interference, humidity, and corrosion, making them more reliable, stable, and durable over time.

The best teaching aid is seeing SHM in action. Glisic took the group to a bridge on the Princeton campus that he has been monitoring with FOS technologies since 2009. Streicker Bridge (background photo) is a recently constructed pedestrian bridge that provides a safe crossing over busy Washington Road for people walking or biking on campus and serves as an in situ lab for FOS technologies.

The Streicker Bridge SHM research project—conducted by Glisic and Princeton’s civil and environmental engineering department—has multiple phases and purposes. In addition to monitoring the bridge’s performance over time, it also is a platform for critical comparison of different sensor types and testing and validation of new technologies. Information gathered through the project will help build reliable algorithms for damage detection and performance degradation based on objective data. Last but not least, it supports teaching and outreach by providing students with hands-on research opportunities and serving as a backdrop for vehicles like the SHM-FOS short course that support tech transfer to the professional community.

More on the web: Read more about the Streicker Bridge at princeton.edu/~bglisic/StreickerBridge.html.

Photo ©2012 Rutgers/Allison Thomas

“Based on our tests, we determined that using smaller shear pocket spacing near the supports would likely reduce the potential for the non-composite behavior observed in the field,” Barr said.

The USU team suggested some other long-term approaches to improve the overall performance of PBES bridges. For example, post-tensioning—pulling bridge decks and girders together like a set of dental braces—is known to significantly extend service life, but has time, cost, and maintenance drawbacks. As an alternative, Barr’s team found that tying deck panels together with reinforced shear keys resulted in comparable structural performance.

Another suggestion was to invest in high-performance concrete for decks, which is more resistant to deterioration from weather extremes, continued load stress, and delamination. As ABC is more widely adopted, research like Barr and his team are doing at USU will help ensure top performance and longevity of bridges built using these methods.

“Many agencies have found accelerated construction beneficial in terms of its reduced construction time, minimal traffic interruption, and in many cases, significant cost savings,” Barr said. “While there may never be a bridge that lasts forever, ABC gives us the means to replace deficient structures quickly and safely while being respectful of the environment. It’s the future of bridge construction.”

Bridge sections are trucked into CAIT-UTC partner Utah State University’s SMASH lab where researchers perform forensic and other testing on full-scale bridge elements. Photo ©2012 Utah State University
The gap between retiring professionals and fresh talent entering the arena is widening all over America, so the challenge to maintain a competent workforce isn’t unique to the transit industry.

To help lessen this imbalance however, the Federal Transit Administration (FTA) is funding a Rutgers project that will promote transit careers and help bring together employers and job seekers.

CAIT and the John J. Heldrich Center for Workforce Development are leading a collective of public and private partners to create a national Transit Virtual Career Network (TVCN). TVCN will be a dynamic online resource that helps public transportation operators attract and prepare the skilled workforce required to operate and maintain a 21st-century transit system. To help recruit a wide range of workers—including veterans, women, and minorities—the network will provide up-to-date information on career paths, jobs, training, and education.

TVCN development is funded by a $650,000 grant from the FTA’s Innovative Transit Workforce Development Program, which helps local public transit agencies and higher education institutions train the next generation of transportation professionals.

“Years, transit employers have been concerned about skilled-worker shortages as more employees reach retirement age, technology and consumer [expectations] change quickly, and demand for transit services increases,” said Jennifer Cleary, senior project manager at the Heldrich Center.

The beauty of TVCN is that it serves both sides of the equation: employers and potential employees.

The website will be “open source/open content,” easy to understand, and simple to follow. It will be written at the 6th to 7th grade reading level and provide users with multiple entry points and navigational paths. It will help job seekers develop qualifications—it even helps them organize their employment search.

“We want to bridge the gap,” says Janet Leli, director of the New Jersey Local Technical Assistance Program, who will lead activities on the CAIT side. “Once interest in a transit career is cultivated and someone begins to gather transcripts, letters of recommendation, and their résumé, they can find and apply for suitable potential jobs using a personal career management account.”

TVCN supports workforce needs for all transit systems throughout the country, but also can be applied locally. In addition to national data, the tool also will have geo-coded state and local (county/MSA) data. This means individuals considering careers in the industry—and people already in the transit field—can learn about labor market conditions and available training, and identify jobs or advancement opportunities in their region or across the country.

New Jersey senators Robert Menendez and Frank Lautenberg fully support the effort and had a role in laying groundwork for the funding that made it possible.

“Working with the banking committee I helped create this competitive grant program, so it is especially gratifying to see a New Jersey applicant win,” said Senator Menendez. “We have an aging transit workforce, so we need to do all we can to attract new talent [that can] run our ever-expanding national transit network. Rutgers will use this grant to help create a new generation of transit workers that will in turn enhance safety and build stronger, more sustainable communities around the country.”

Senator Lautenberg, a member of the appropriations subcommittee that funds DOT, adds “Transportation is the backbone of New Jersey’s economy, and this federal funding will help Rutgers and local agencies recruit talented students and veterans to lead this important industry. Investing now in our transportation workers will benefit our state for years to come.”

The TVCN website will launch in 2015. It is modeled after other federal initiatives, including a similar website for the health care industry and an e-learning platform created by the U.S. Department of Energy.

CAIT and the Heldrich Center will work closely on the project, enlisting the help of the American Public Transportation Association and its member agencies. Other partners include the American Association of Community Colleges, the XPand Corp., and the National Association of Workforce Boards.
Ninety percent of all international cargo moves through marine ports, which means maritime transportation and infrastructure is critical to the global economy.

Ships move billions of dollars worth of goods, but they also are one of the largest sources of air and water pollution in the world—and among the most difficult to regulate.

Reducing energy consumption, dependence on fossil fuels, and carbon emissions, while increasing efficiency and lowering costs are hot topics in the shipping world. This means not just for the sea-going vessels, but also in port facilities, where energy makes up a hefty portion of overhead costs for terminal operators.

Energy consumption also is fueling something else: competition.

The world’s largest ports already have adopted formal policies and practices to enhance the environmental, social, and economic sustainability of their operations. In addition, ports and transportation providers are looking at long-term sustainability strategies to achieve their common goals.

Under the auspices of CAIT’s Laboratory for Port Security (LPS), organizers Dr. Mohsen A. Jafari and Dr. Birnur Ozbas brought together prominent international agencies, academics, and commercial interests on March 1 to discuss these issues at Rutgers’ Port Sustainability and Energy Security Workshop.

This one-day workshop united 58 public and private stakeholders and experts (see participants list on opposite page) to brainstorm and examine the impact of energy and sustainability on port operations and growth. Discussions explored current and future challenges, lessons learned from around the world, venues for additional initiatives, and collaboration among industry, government, and academia.

Captain Blaine Collins, director of external affairs for DNV-KEMA in North America, facilitated the first panel on port sustainability from the U.S. perspective. Panelists included representatives from PANYNJ, POLA, POLB, POS, and SJPC.

William Nurthen, innovation director and senior vice president of PANYNJ, led the second panel, which focused on European issues, advances, and road maps to success. The panelists included experts from DNV-KEMA, IAPH, and the ports of Antwerp, Gothenburg, and Rotterdam.

The third panel focused on port user and third-party perspectives. Abbas Sarmad, senior vice president of AECOM facilitated the discussion, and Best Transportation, CSX, EPA-Region 2, IKEA, and MAERSK gave presentations on corporate strategies and plans to work with ports.

Dr. Ali Rezvani, freight transportation analyst at Moffatt & Nichol, led the fourth panel.
which focused on energy security, with representatives from DNV-KEMA, NYSERDA, PANYNJ, PJM, PSE&G, and USCG.

LPS program manager Dr. Birnur Ozbas facilitated the final panel of the day, which covered sustainable port infrastructure and operations. Panelists included representatives from AECOM, Moffatt & Nichol, PANYNJ, POLA, POLB, and POS.

The meeting already has initiated new collaborations between participants. CAIT will conduct several workshop follow-up activities to maintain an open dialogue on port operations, including an annual meeting at Rutgers and a port sustainability and energy security group on LinkedIn.com.

More on the web: Workshop proceedings (permitted by presenters), a list of attendees, and contact information at cait.rutgers.edu/lps/port-workshop-2013-recap.

PARTICIPATING ORGANIZATIONS

AECOM
Best Transportation
CSX Transportation
DNV-KEMA Energy & Sustainability
Environmental Protection Agency (EPA)
Greener by Design
IKEA
International Association of Ports and Harbors (IAPH)
MAERSK
Maher Terminals LLC
Moffatt & Nichol
New York State Energy Research and Development Authority (NYSERDA)
PJM Interconnection (PJM)
Port Authority of New York and New Jersey (PANYNJ)
Port of Antwerp
Port of Gothenburg
Port of Los Angeles (POLA)
Port of Long Beach (POLB)
Port of Rotterdam (POR)
Port of Seattle (POS)
Public Service Electric and Gas (PSE&G)
Rutgers’ Bloustein School of Planning and Public Policy
Rutgers Business School
Rutgers’ Center for Advanced Infrastructure and Transportation (CAIT)
Rutgers EcoComplex
Rutgers’ Energy Institute
South Jersey Port Corporation (SJPC)
U.S. Coast Guard (USCG)

A history of passion for engineering

CAIT 2012 UTC Student of the Year

Christopher Mazzotta has been a history buff since he was a kid growing up in Cape May, New Jersey. But in all his studies, it was historic engineering feats—from ancient Rome’s aqueducts to President Eisenhower’s legislation spurring our interstate highway system—that captured his imagination and drew him to civil engineering.

“I enjoy discovering how past peoples went about their day-to-day lives and how infrastructure affected them. For instance, so many aspects of our lives are mirrored in ancient Roman culture, especially the infrastructure that they built,” said Mazzotta when asked about his dual interest in history and engineering. “Many engineering techniques that we are ‘discovering’ today actually appeared in Rome hundreds of years ago—like ‘no-slump’ concrete for dam construction. Studying the past allows us to better prepare for the future.”

Mazzotta’s academic performance, intellectual curiosity, and dedication to pursuing excellence in civil engineering, all factored in CAIT naming him 2012 UTC Outstanding Student of the Year.

Mazzotta was blindsided by the announcement: “Dr. [Patrick] Szary asked me to submit some information to be considered for an award, but I didn’t exactly know what it was. So I was really surprised when they told me I’d been chosen to receive the UTC award at the TRB annual meeting in Washington, D.C.

“It was my first experience at TRB, and it was very exciting. I got to meet young engineers and researchers from all around the country. I also met a few people from the American Public Transportation Association and NJ Transit. I enjoyed that because I want to work to improve my home state,” said Mazzotta.

Mazzotta is currently a master’s student in civil and environmental engineering and will pursue his Ph.D. next. His primary focus is structural engineering, though he also has a keen interest in geotechnical engineering and water systems.

At CAIT, he gets to work on the modern infrastructure systems whose ancestors initially inspired him. He is part of CAIT’s Infrastructure Condition Monitoring Program (ICMP) team, which researches, applies, and promotes the use of nondestructive evaluation (NDE) technologies to help determine the health of bridges and other structures.

Mazzotta has experience with several different NDE technologies and is currently engaged in a specific project that is investigating how NDE can be used to determine the condition of prestressing strands in concrete bridge girders. Ultimately, this research aims to develop assessment protocols that will help inspectors in the field.

Christopher Mazzotta, 2012 UTC Student of the Year. Photo ©2013 Rutgers/Allison Thomas

Photo ©2013 Rutgers/Allison Thomas
The first two phases of the FEMA research concentrated mainly on evaluating mitigation strategies for inundation from heavy rainfall and stormwater runoff, which were the significant factors during prior hurricanes in New Jersey.

But Superstorm Sandy—which happened to coincide with a naturally occurring exceptional high-tide cycle—brought a combination of wind and storm surge never before seen in the state. Even though it lacked the unrelenting rainfall (and in the case of Irene, pre-existing ground saturation) of the other storms, the severity and breadth of destruction from Sandy was far greater than that caused by any previous hurricane the region had experienced. As a result, officials have little or no historical data to compare it to.

Phase III is examining wind and storm-surge damages caused by Sandy to communities within Ocean County and how housing, businesses, and critical infrastructure can be rebuilt with greater resilience. Collecting vast amounts of fine-grained topological data (such as elevation, grade, and ground characteristics) and land use data (such as type and density of development versus open space), and overlaying that information with detailed economic mapping of insurance payouts, will let officials visualize not just the risks, but also more accurately estimate costs likely to be incurred during future storms and what changes should be made on a planning level to lessen their physical and financial consequences.

Because of the unprecedented storm surge of Superstorm Sandy, FEMA is proposing new flood maps that—according to some reports—could add as many as 65,000 structures in New York and New Jersey to the 100-year flood zones. Everyone in 100-year flood zones is required to get flood insurance if they have a federally backed mortgage.

Of particular concern are properties that fall in “V Zones,” defined by FEMA as “areas along coasts subject to inundation by the one-percent-annual-chance flood event with additional hazards associated with storm-induced waves.” Homeowners rebuilding in these V Zones will not only be required to build above the base flood elevation (BFE), but also use stilts, pilings, or other methods of raising the house that can withstand hurricane-level wave action.

Clearly, there is a lot at stake for many residents in the region, making the kind of data gathering and analysis being undertaken by Rutgers very important in a practical sense.

Phase IV of the FEMA project plans to do the same work as Phase III, but expand the study from Ocean County to the other seven New Jersey counties that sustained significant damage from Sandy.

“The gathering data—no matter how exhaustive and relevant—is basically pointless if it can’t be put to use,” says Mayer. “Analyzing, combining, and visualizing different types of data—like physical and structural damage data obtained with LiDAR and mapping financial losses, geographic data, or percentage of impervious surface area—so that the people who need it can access and understand it is where the real value lies.”

The “products” that will come out of this work not only will help FEMA determine where the greatest risks lie, but also will create resources, maps, and training/educational products to guide homeowners and businesses by giving them tools to show the current elevation of their dwelling, how much they should raise the structure when rebuilding, and if any structural fortification is required. These resources also give county and local authorities the means to better understand and see the most vulnerable areas in their municipalities so they can make decisions about development as well as response and recovery plans.

The overarching objectives of all four phases are to diminish hazards, mitigate flooding, and identify resiliency strategies that will reduce loss of life and property.

Do dunes make a difference? Protecting coastal communities

The need to make our infrastructure and housing more storm resistant and resilient is widely recognized, but how will decision makers determine the most cost-efficient strategies and select and prioritize investments?

CAIT is funding a project, which supports the broader FEMA research, that seeks to understand how Sandy’s damage along the New Jersey coast correlates to land use and other local characteristics. Bloustein School
professor and director of the Environmental Analysis and Communications Group Dr. Michael Greenberg and CAIT Laboratory for Port Security program director Dr. Birnur Ozbas will work together, investigating whether modifying or adding protective infrastructure (e.g., sea walls, sand dunes, breakers) could curtail damage caused by storm surges.

Specifically, the team will examine five selected zones in Ocean County, New Jersey, that suffered varying levels of damage. After reviewing literature, talking with experts, visiting sites, and pouring over case-study successes and failures, they will report on how effective sand dunes were at reducing impacts from Sandy, not just along the beaches, but also in locations a considerable distance inland from the shoreline.

According to Ozbas, “The results will be very helpful in strengthening the process used when developing and updating hazard mitigation plans at the county level and increasing involvement and knowledge among municipal and county planners as well as the general public.”

Climate change: The wild card in risk assessment?
While engineers, planners, and policymakers wrestle with the effects storms have on our built environment, climatologists, ecologists, and marine biologists are trying to understand and predict trends in the natural environment. The work is inextricably linked.

Working with the National Oceanic and Atmospheric Administration (NOAA), researchers at Rutgers School of Environmental and Biological Sciences have created NJFloodMapper (njfloodmapper.org), an online tool that identifies parts of the state in danger of significant flooding if the ocean and bays continue to rise as expected.

“While sea-level rise is a global phenomenon, adapting to it is a local decision-making challenge that is going to require site-specific remedies,” said Richard Lathrop, professor of environmental sciences and director of the Grant F. Walton Center for Remote Sensing and Spatial Analysis. “Hurricane Sandy showed us that local land-use planners and managers need access to detailed information about what and who may lie in the path of rising sea levels—and the path of high tides and storm surges factored on top of those new, higher sea levels.”

With NJFloodMapper, anyone can simulate sea level rises of one foot (the rise many scientists expect in the next 50 years) to six feet. Users can see the BFEs recently released by FEMA, and 100-year and 500-year flood information. Maps depicting areas affected by Hurricane Sandy’s storm surge also are included. In addition, the tool shows which schools,
hospitals, and fire and police stations—as well as homes and businesses—are particularly vulnerable to flooding and can help towns and counties prepare for rising sea levels.

NJFloodMapper includes “street views” at selected locations that demonstrate what sea level rise will look like. Finally, NJFloodMapper also will show which communities are most vulnerable to sea level change and flooding—not just due to location, but also based on the age and relative socioeconomic makeup of their population. Poverty can affect a community’s ability to prepare for storms and rebuild afterward.

Lathrop and his colleagues created NJFloodMapper in collaboration with NOAA’s Coastal Services Center and the Rutgers-managed Jacques Cousteau National Estuarine Research Reserve. Lisa Auermuller, watershed coordinator for the Cousteau Reserve, said she and Lathrop involved local and county officials from the beginning and had them test the tool. “We didn’t assume that ‘if we built it, they will come,’” she said. “We listened to what they wanted and included those things in the project, so we knew the finished product would be useful.”

NOAA’s Cooperative Institute for Coastal and Estuarine Environmental Technology, Sustainable Jersey, New Jersey SeaGrant, and the New Jersey Department of Environmental Protection funded the project.

**Up-to-date Information and training for engineers in changing times**

In February 2013 the New Jersey Local Technical Assistance Program (NJ LTAP) teamed up with FEMA on a technical presentation for the New Jersey State Association of County Engineers that covered advisory BFE maps and hazard mitigation grants. The program addressed changes in flood maps and allowable expenses for various FEMA grants.

NJ LTAP also is working with FEMA to bring seminars to the construction, design, and inspection communities on coastal construction following the storm. Two classes were offered in April, “Introduction to Coastal Foundation Design and Construction” and “FEMA Best Practices for Flood and Wind Mitigation.” These sessions explained residential and commercial construction codes and offered information on retrofitting and new construction techniques to improve hazard resistance.

**One storm, many lessons**

It will take years for the region to fully recover from Sandy’s crushing blows, but Rutgers is doing what it can to ease and accelerate the process of bringing communities back to normal. What is learned in evaluating storm damage, examining efficacy of mitigation/resiliency strategies, reducing surge and other flooding, and improving land use along the mid-Atlantic coast can help provide coping mechanisms for natural disasters all over the world.
Disaster and inspiration

Superstorm Sandy prompts professional and amateur filmmakers

Humans have been telling stories since we learned to speak and possibly even before. Tragedy is compelling subject matter; when disaster strikes millions of people at once, millions of stories are born.

Even while Superstorm Sandy still raged outside, videos—television news footage to blurry cell phone YouTube clips—appeared. Weeks later however, crafted documentaries about the storm and its aftermath began to emerge.

These documentaries seem to fall into two general categories. One type follows an “objective model”—chronology, scientific information, and eyewitness and expert testimony. The other group comprises stories told from an extremely personal point of view. Films from either category may have a specific agenda, such as raising awareness of climate change or inspiring volunteerism or charity. Others seem only to spring from our basic need to share our experience. Both types have a purpose and value.

But what do disaster documentaries have to do with infrastructure? The same thing history books do. They remind everyone of how much we depend on it. Beyond that, the storm showed us our systems’ vulnerabilities; a visual record of that, combined with powerful storytelling, ensures we don’t forget the lessons learned.

One of the first productions to air, the PBS NOVA program Inside the Megastorm, takes viewers through events as they unfolded and questions whether Sandy was a freak occurrence or an indication of things to come. Through first-person accounts and interviews with experts, the episode gives scientific context to a new breed of storms and discusses mitigation and protection options. (54 minutes)

video.pbs.org/video/2305482040

Superstorm New York: What Really Happened, a production from National Geographic, also recounts the storm chronologically and includes interviews with eyewitnesses, scientists, and historians. It includes an excellent segment from the NOAA Hurricane Research Division that explains the mechanics of the storm and stresses the importance of collecting quantitative data to fully understand these events. (45 minutes)

youtube.com/watch?v=bP1EdsiEO8o

The First 36 Hours: An Inside Look at Hurricane Sandy tells the dramatic story of a local news team and what they went through to get their story on the air. (21 minutes)

vimeo.com/52760964

Filmmaker Casey Neistat produced three short pieces during and immediately after the storm. Hurricane Sandy on Bikes in New York he shot with his brother as they rode through lower Manhattan for four hours during the storm. Staten Island Hurricane Destruction was shot just a few days after the storm. With $500 he got from licensing footage from the “on bikes” video, he purchases and takes a load of “I Love New York” sweatshirts to heart of the devastation on the southeast coast of Staten Island. Hitch a Ride to Rockaway Beach captures the scene there when a nor’easter hit the area only a week after Sandy. (Films range from 2 to 7 minutes)

caseyneistat.com/#83a/youtube

The Rockaways in Queens, New York, suffered some of the worst damage of any region. Several quality films have come out of the tight-knit blue-collar communities and subculture of surfers who reside there.

Above right: In January 2013 this battered bumper car still sits where it washed up more than a mile away from the boardwalk in Seaside, New Jersey.

Left: A defiant homeowner on Staten Island uses his house to declare the neighborhood’s determination and spirit.

Beach 87th St./Surfing after Sandy is a well-produced story told by homeowners who did not heed the evacuation orders. It explains a bit about the surfing culture in the area and conveys the sense of community as well as the emotional impact of loss. Surfing after Sandy contains evocative imagery and provides narrative from an area that did not get a great amount of coverage in the mainstream media. (15 minutes)

vimeo.com/56290484#

In Breezy Point, more than 100 homes burned to the ground as firefighters—many of them residents—struggled against the elements to reach the inferno. The Rider and the Storm, produced by David Darg and Bryn Mooser, follows Timmy Brennan, a New York ironworker whose true passion is surfing. His house was among those consumed in the fire. As he digs through the ruins day after day trying to recover, he discovers the kindness of strangers and finds solace again on the ocean. The 16-minute film was screened at the 2013 Tribeca Film Festival. (Trailer only)

vimeo.com/61554023

Beach 119 chronicles the experience of people on one street in the Rockaways. Just 24 miles away from Manhattan where things had mostly returned to normal, Beach 119th Street was cut off from help with no power, water, gasoline, or heat for many weeks after the storm. The film tells the story of Beach 119th residents coming together to survive the trauma and expresses their gratitude to people who responded to the neighborhood’s pleas for help. (Trailer only)

Beach119.com
Rutgers pavement lab gets AASHTO stamp of approval eight years running

In early February 2013, CAIT’s Pavement Resource Program (PRP) was reaccredited for the fourth time as an AASHTO Materials Reference Laboratory (AMRL).

To earn this designation, equipment, personnel, and the quality control systems of Rutgers Asphalt Pavement Lab were scrutinized over a four-day period during which AMRL assessors monitored every detail to ensure technicians are following strict testing standards and procedures and that the lab’s equipment is properly calibrated and operated. In order to maintain AMRL accreditation, labs must recertify every two years.

In total, PRP demonstrated competence in a total of 34 different test methods related to bituminous materials—nine asphalt binder test methods, 14 hot mix asphalt tests, and 11 aggregate tests. This topped the already impressive 30 tests they had previously been certified to do. The four new tests added to the “repertoire” are:

- ASTM D5405, Multiple Stress Creep Recovery (MSCR)
- AASHTO T164/ASTM D2172, Quantitative Extraction of Asphalt Binder from HMA
- AASHTO T305/ASTM D6390, Draindown Characteristics of HMA
- ASTM D5404, Recovery of Asphalt from Solution by Rotavapor Apparatus

PRP Director Dr. Tom Bennert expressed great pride in the team’s accomplishment: “The guys did a tremendous job over the past several weeks, both prepping the lab and all through the assessment.” Lab supervisors Ed Wass Jr. and Chris Ericson coordinated the HMA/aggregate and asphalt binder testing, respectively. “Ed and Chris carried a big part of the load organizing and working with their crews to ensure all the equipment and materials were verified, calibrated, and ready to go,” said Bennert. He also praised lab researchers and technicians Darius Pezeshki, Brett DiFrancesco, and Donatas Zvirblis for their help both before and during the process.

“It was a great team effort,” said Bennert. “We wouldn’t have successfully secured this prestigious certification without everybody pitching in. The guys really deserve recognition for all of their hard work.”

AMRL accreditation signifies that the PRP lab meets materials testing requirements for FHWA, USDOT, FAA, the Army Corps of Engineers, and other federal and state transportation agencies. Rutgers is one of only a handful of university-based labs to hold that distinction.

CAIT resident NDE expert named Faculty of the Year

Dr. Nenad Gucunski is CAIT’s leading nondestructive evaluation (NDE) expert and an internationally recognized infrastructure systems specialist. Professor and chair of the Rutgers civil engineering department, he was named 2013 Faculty of the Year for his outstanding achievements in scholarship, teaching, and service. School of Engineering Dean Thomas Farris presented the award at a ceremony April 5.

Gucunski directs several CAIT programs in infrastructure condition monitoring, such as the ANDERS project, and is a crucial part of the LTBP program. He was team leader on the recent groundbreaking development of a robotic system for evaluating bridge decks. That project was funded by FHWA, whose administrator, Victor Mendez, called it “really, really amazing” and “at the forefront of a new industry.”

Gucunski has been noted for his unique ability to build teams for critical large-scale projects. As a result of his effective collaboration with academia, agencies, and private contractors, he has consistently secured major awards, including projects from USDOT, FHWA, NIST, TRB, and others.

His expertise is frequently sought by a wide range of government and industry groups. He has served as a technical consultant to many agencies including the NJDOT, the New York City Department of Transportation, the Port Authority of New York and New Jersey, U.S. Army Marine Corps, and the United Nations Development Program for India.

Gucunski received his bachelor’s degree from the University of Zagreb, Croatia, and his master’s and doctoral degrees from the University of Michigan.

China and United States share pavement “secrets”

When Dr. Anil Agrawal from the City University of New York (CUNY) hosted a delegation of engineers from China last year for a discussion on bridge design, he didn’t know they would come back so soon. About a year later, they asked to learn about U.S. pavement construction and pavement management systems (PMS).

CUNY is the lead institution of the Region 2 UTC of which CAIT is a partner. Agrawal is a bridge expert, not a pavement expert, so he turned to CAIT’s Pavement Resource Program (PRP).

PRP sent their pavement “A” team: senior research fellow and engineer Dr. Nicholas Vitillo and Rutgers civil engineering professor Dr. Hao Wang. CAIT research project manager Brian Tobin and research assistant Michael Boxer attended to help answer questions.

The Chinese delegation included government officials and representatives from private contractors and was led by Mr. Chen Yuehui, deputy commissioner of Anhui Province Department of Transportation.

At the meeting, hosts and guests learned about each other’s paving technologies, equipment, and specifications and—in keeping with CAIT’s collaborative values—shared information and ideas for the good of both countries.
Grad researcher on the road to success

Rutgers engineering research assistant Edwin Haas III received the Michael Manno Scholarship from New Jersey’s Construction Industry Advancement Program (CIAP) at the 2013 Rutgers Asphalt Paving Conference. Each year, CIAP selects a student pursuing a career in pavement and presents the scholarship in honor of the asphalt legend for which the award is named.

Haas completes his master’s degree this spring and will immediately continue with his doctoral studies. He has worked in the Rutgers Asphalt Pavement Lab since 2009, where he started out doing hot mix research and testing. He is now involved in pavement acoustics research.

“I was drawn to asphalt because it’s one of the few things almost everyone interacts with on a daily basis—well, at least until we get flying cars,” he joked. “People don’t realize how widely asphalt varies road to road. They don’t really notice when it’s good, but they do when it’s bad.

“I’ve always loved construction—whether it’s building new or rehabilitating existing. It’s really satisfying to create something, then walk away and see it being used. I wanted to be involved in improving asphalt because it’s a really good way to have a positive impact on a lot of people’s lives,” Haas says.

Winning the Manno Scholarship comes on the heels of Haas receiving another $25,000 match award last fall, the Advanced Institute for Transportation Education (AITE) Graduate Scholarship.

Regarding his future in transportation, Haas says, “I know I’ll always work in infrastructure in some capacity, but my pie-in-the-sky dream is to own my own paving company someday.”

Haas may just be starting his career, but his academic performance and perseverance to date indicate he’s well on the way to reaching that goal.

Complete “how to” for processed dredge material

New York and New Jersey waterways carry 145 million tons of goods and commodities annually. Few of us will ever ride these “marine highways,” but like any other transportation system, they require continual maintenance.

Approximately 550,000 cubic yards of accumulated sediment is dredged out of New York Harbor alone each year. That’s enough material to cover a regulation football field in mud 260 feet deep!

In general, waterway sediments lack the geotechnical properties necessary for structural landfill unless they are modified. How much sand, silt, and/or clay is contained in the material, and whether or not it’s contaminated, influences where it can be used and how it should be properly prepared for its end use.

Positive and profitable reuse of this material for habitat or beach restoration, for brownfield cover, or as highway and other construction fill, is far preferable to hauling and storing it in confined disposal facilities. In fact, NJDOT views dredged material as a natural resource and encourages beneficial use over other management options.

Reusing dredged material isn’t a new idea, but it’s a considerably underutilized alternative to disposal. That may be because there was no central “how to” resource on best ways to process and use dredged sediments. Until now.

NJDOT Office of Maritime Resources project manager Scott Douglas has been the driving force behind a joint project with CAIT’s Soil and Sediment Management Laboratory (SSML) to develop a comprehensive manual for integrating process dredged material (PDM) into common construction applications.

The Processed Dredged Material Manual covers research, development, and implementation of new dredged material management techniques. It guides engineers, dredging professionals, and project engineers on how to maximize benefits, and details necessary considerations for handling and using PDM.

The manual covers geo-chemical and geo-technical characteristics of sediment specific to New York/New Jersey waterways, and methods for evaluation, transport, processing and stabilization, decontamination, placement, and quality control protocols. It also includes detailed case studies of beneficial use success stories, such as the Jersey Gardens Mall and Bayonne Golf Club.

Below: The Bayonne Golf Club was constructed using approximately 2 million cubic yards of processed dredge material. Photo ©2010 Stewart Abramson
Step-by-step pedestrian safety for engineers

CAIT combats pedestrian deaths with safety symposium just for engineers

New Jersey is an FHWA-designated pedestrian and intersection focus state that is dedicated to reducing pedestrian fatalities and improving safety for all road users. Roadway improvements are most successful when they are approached with a combination of education, enforcement, and—of course—engineering.

On March 21, the New Jersey Local Technical Assistance Program (NJ LTAP) hosted more than 200 local, county, and state engineers at the first Designing for Pedestrians: An Engineering Symposium. Developed with support from the FHWA Office of Safety through the Accelerating Safety Activities Program, the symposium focused specifically on engineering aspects of pedestrian safety.

Karen Scurry, transportation specialist with the FHWA Office of Safety, gave a keynote address on safety culture and road-user interactions. “No matter how you look at the data, the basic problem is the same—pedestrians and drivers must use the streets together—so we have to design to accommodate both,” Scurry said.

Attendees were briefed on the full process of making safety improvements: identifying problem locations/analysis, implementing countermeasures, and funding. Michael Weber, Transportation Safety Resource Center engineering researcher, spoke on using crash data to identify problem spots, then FHWA-NJ safety engineer Caroline Trueman instructed the group on how to conduct road safety audits at those locations.

Countermeasure recommendations are the first step in making streets safer; obtaining feasible financing options is the second. Christine Mittman, New Jersey Transportation Planning Authority project manager, offered guidelines and avenues to funding local safety projects.

With budgets tight on both the state and federal level, effective, low-cost enhancements are favorable. Rosemarie Anderson, FHWA Office of Safety transportation specialist, and Susan Poliwka of the mobility and planning division for the City of Hoboken, offered several cost-effective solutions, including curb “daylighting,” a practice that forces cars to park farther away from intersections, improving visibility so pedestrians and motorists can see and react to each other more quickly.

Sometimes, simple design upgrades can improve safety dramatically. Matthew Carmody, P.E., a senior project manager with engineering firm VHB, spoke about innovative safety improvements from New York City that can easily be implemented throughout the region, like installing corners or medians at crosswalks. Chris Barretts, P.E., manager of the NJDOT Division of Traffic Safety and Engineering, suggested retiming signal heads with an advance walk interval to give pedestrians a “head start” when crossing the street.

Two panel discussions took a closer look at visual- and auditory-alert technologies for crosswalks and intersections. Moderated by NJ LTAP’s Ted Green, P.E., the panels explored technologies for both signalized and unsignalized intersections, like audible warning bells and crossing instructions, pedestrian-controlled HAWK beacons, and “Stop for Pedestrian” signs in highly-congested areas.

“These technologies will help to make both motorists and pedestrian more alert,” Green said. “Coupled with enforcement and education, we’re looking forward to seeing a downward trend in crashes and fatalities that directly correlate with these engineering improvements for pedestrians and everyone else.”
56th Annual Rutgers Asphalt Paving Conference

Rutgers Asphalt Paving Conference is the second largest statewide pavement event in the country and has been New Jersey’s top venue since 1957.

It annually attracts more than 400 consultants, contractors, suppliers, designers, government agency employees, researchers, and other paving professionals. CAIT and the New Jersey Asphalt Pavement Association (NJAPA) host the conference, which provides a forum to discuss innovative materials and issues facing the pavement industry.

Held this year on March 5–6, The first day concentrated on current status of the pavement industry. Dr. Tom Bennert, director of CAIT’s Pavement Resource Program (PRP), opened with a recap of this year’s research achievements, including recent AASHTO reaccreditation of PRP’s paving lab, which is now certified in a total of 34 tests. (See story on page 24.)

Asphalt consultant Dale Decker was next with “Back to Basics,” a lesson in field and plant operations and quality control. He focused on laydown procedure, mix designs, and QC methods, and reminded everyone they play important roles in well-laid pavement.

Robert Blight and Narinder Kohli from NJDOT wrapped up the first day with agency updates, a recap of IRI specifications implementation, and a positive report on New Jersey highways: “good pavement” is increasing, and “poor pavement” is decreasing.

The second day of the event explored exciting new materials to make pavements stronger and more resilient. Eileen Sheehy, manager of NJDOT Bureau of Materials, first offered a state perspective on materials production. “The state’s pilot project using high RAP mixes was a big success,” Sheehy said.

Bennert gave an update on use of warm mix asphalt technologies in New Jersey and beyond.

Gaylon Baumgardner, executive vice president of Paragon Technical Services, Inc., shared some of his national experiences with rubber-modified mixes and binders.

Ernie Blais, division administrator of the Federal Highway Administration—New Jersey, offered his insightful federal perspective on guidelines and expectations under MAP-21.

Finally, Brian Crain—an OSHA compliance officer and former state trooper who has logged a lot of road hours in work zones—closed the conference with a sober and memorable talk on the importance of maintaining proper work zones for the safety of both workers and the driving public.

May 22–24, 2013 • Annual Institute of Transportation Engineers Northeastern District Conference
Northampton, Massachusetts

June 10–13, 2013 • Council of University of Transportation Centers Summer Conference
Memphis, Tennessee

July 17–19, 2013 • International Symposium on Transportation and Traffic Theory
Noordnijk, Netherlands

July 22–25, 2013 • National LTAP/TTAP Conference
Boise, Idaho

August 25–28, 2013 • APWA International Public Works Congress and Exposition
Chicago, Illinois

More on the web: Information on upcoming CAIT-sponsored events can always be found at cait.rutgers.edu/cait/events.