

Center for Advanced Infrastructure and Transportation **transportation today**

No Bridge Too Far: NDE Testing for Iowa DOT

As a result of its ever growing national reputation for nondestructive evaluation (NDE) expertise, CAIT's Infrastructure Condition Monitoring Program (ICMP) was recently called on to help the Iowa DOT decide if they should adopt NDE as part of the arsenal for evaluating and addressing bridge deck deterioration in their state.

ICMP's cadre of experts—using a suite of state-of-the-art NDE equipment—has done evaluation testing and surveys for several states including Utah, Virginia, and California. Last March, CAIT also received a grant from the National Academy of Sciences Strategic Highway Research Program (SHRP2) to audit NDE technologies and evaluate their various capabilities and limitations. ICMP's latest contract to inspect decks of nine bridges in Iowa and provide data on their condition meshed perfectly with the work they are doing on SHRP2 and other projects.

Sandra Larson, director of the Bureau of Research and Technology for the Iowa Department of Transportation, first became interested in what CAIT could do for her state when she heard about ICMP's capabilities in connection with work the group is doing on the FHWA Long-Term Bridge Performance (LTBP) program. CAIT is the primary contractor on LTBP, and Larson has taken an active interest in that project from the start.

In addition to gathering important data on the Iowa bridges, the project also was intended to demonstrate the value of NDE technologies and test which specific NDE tools and methods are best applied to the state's bridge

inventory. Francisco Romero, senior researcher for CAIT's ICMP, says, "Iowa is out front

on this type of thinking. They are one of the only states investigating all of these different technologies combined to see which works best for them." NDE has been around for quite some time, but many highway agencies have been slow to adopt it as a requisite tool in their operations for bridge management.

"The Iowa Department of Transportation was interested in pursuing nondestructive evaluation testing with Rutgers' CAIT because they combined multiple NDE technologies into a single project," says Larson. "Following the NDE evaluation, six of the bridge decks were repaired, and a comparison was made

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ICMP Senior Researcher Francisco Romero uses ground-coupled, ground-penetrating radar (GPR) to survey a bridge deck in Iowa. Contracted by Iowa Department of Transportation, a team of six CAIT researchers spent several weeks evaluating nine bridges in the state. A variety of NDE technologies were tested and validated to see which best suited Iowa's particular inventory and issues.

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Looking Back, Moving Forward

We closed 2009 having made many significant accomplishments in all aspects of CAIT's operations. Our productivity was at its highest level ever in terms of winning important research projects, expanding our educational programs, and, most importantly, providing meaningful service to our local and national stakeholders.

Just as this newsletter was being prepared to go to press, we learned that CAIT received a major competitive research award from the National

Institute for Standards and Technology (NIST) for a \$17.9 million project to develop evaluation methods and technologies aimed at improving bridge maintenance and safety. This award, which complements our work on the FHWA Long-Term Bridge Performance (LTBP) program, places CAIT at the core of infrastructure research in the United States. A strong feature of the NIST project is our continued collaboration and teamwork with other universities and industry. Having long been a propo-

nent of private-public partnerships, we look forward to working with our project team members to address one of the most pressing challenges facing our country's surface transportation system now and in the future: management and preservation of the bridges in our highway network.

We look forward to another successful year working with all of our academic, agency, and industry colleagues and partners. I wish you all the best in 2010.

Ali Maher, CAIT Director ■

NIST Awards CAIT \$17.9 Million Project

Research to Advance NDE Bridge Deck Evaluation and New Repair Technologies

CAIT's Infrastructure Condition Monitoring Program (ICMP) was awarded a U.S. Commerce Department grant that will support a \$17.9 million project aimed at improving bridge maintenance and safety. Funding came from the National Institute of Standards and Technology (NIST) under its Technology Innovation Program (TIP). TIP is a merit-based, competitive program that provides cost-shared funding for innovative, high-risk research in technologies that address critical national needs. This year's NIST-TIP competition sought projects addressing two broad areas of national interest: 1) practical application of advanced materials; and 2) monitor-

ing or rehabilitation of major public infrastructure systems, including water systems, dams and levees, and bridges, roads, and highways.

The ICMP team at CAIT identified a great need for advances in condition evaluation and early-intervention repairs for bridge decks. Between 50 and 85 percent of bridge maintenance costs go toward deck repair or replacement. The need for new assessment and repair methods was confirmed by interviews with bridge engineers across the country done in connection with CAIT's work on the FHWA Long-Term Bridge Performance (LTBP) program. "By-and-large, crews today inspect bridge decks visually and

manually, looking for visible cracks or dragging chains across the decks while listening for sounds that indicate hidden flaws," said ICMP Director Nenad Gucunski. "While moderately effective when done by experienced crews, these techniques are slow and they rely on human interpretation and judgment."

The NIST-TIP project is formally known as the Automated Nondestructive Evaluation and Rehabilitation System (ANDERS) for Bridge Decks. A quantitative condition assessment component of ANDERS will use nondestructive evaluation (NDE) technologies to identify and characterize localized deterioration. Expectation is that this data also will help shed light on how deterioration affects the bridge's overall performance. A second component of the ANDERS project will develop materials and robotic equipment for deployment of early-deterioration stage repairs.

If successful, the ANDERS project will provide unique tools that enable sustainable management and effective repairs of our nation's aging bridges. The program kick off is planned for February 2010. ■



Intraculture: Infrastructure in the Mainstream

The Intersection of Infrastructure Information and the Internet

There's no denying that infrastructure issues have gained significant visibility in the last three to five years. Some attribute this trend to the 2007 Minneapolis bridge collapse and increased media coverage. But whether it was a single tragedy or a gradual cumulative process, public awareness has inarguably increased. I think we can all agree this is a positive development that is long overdue.

Infrastructure's boosted profile has spawned a proliferation of online media addressing infrastructure issues. If you think blogs, social media, web compendiums, and other new media sources don't deserve attention, you're missing out on some valuable information—and a convenient way to get it.

Trusted, established professional and industry resources, such as *ASCE Smart-Briefs*, *ENR Insider*, *ENR News Alert*, and their ilk have served the infrastructure community well for years, but new electronic media offers ingress to even broader and more diverse news, opinions, and perspectives than those available on traditional aggregate sites.

Social media—mainly Facebook, Twitter, and YouTube—has infiltrated the establishment. Using these platforms has become so pervasive and widely accepted that you can now follow tweets from Transportation Secretary Ray LaHood and tune in to the House Committee on Transportation and Infrastructure YouTube channel.

Presented here is a small but varied sampling of infrastructure-related blogs and websites. Creators and editors of these sites range from the federal government, to lobbying organizations, to grassroots advocacy groups.

CAIT does not endorse any of these websites or the opinions of their sponsors and contributors, but I offer you a few examples I have found particularly interesting. Hopefully, they will whet your appetite and help jump start your own exploration into a virtual wellspring of information. I encourage you to consider these and others, to discover your own sources, find the causes you believe in, or just to see what everyone is saying about the issues. Happy surfing.

Allison Thomas, Editor and Associate Director of Marketing and Communications, CAIT



infrastructureusa.org

This "citizen dialog about civil infrastructure" is a project of Anderson Productions Ltd (APL), a communications, media, and consultancy firm out of New York City. This online community aims to inform and generate conversation about our country's aging infrastructure.

In the section "Infra Views," experts—public policy leaders, trade associations, and think tanks—weigh in with analysis on infrastructure issues. Of particular note are a resources section and their "Infra Blog," both easily accessible from the main navigation.

One feature of the site is the ability to navigate to very specific topics—from accountability to water treatment—via a list of categories on top-level pages. It also offers an infrastructure poll (vote to see results) and a "Show Us" area for readers to upload video, photos, and stories about infrastructure that needs attention in their own communities.

infrastructurelist.com

Infrastructurelist.com is one of the richest sources for infrastructure news and opinion, and one that subscribes to no specific agenda. Posted stories are pulled from national and international newspapers like the *New York Times*, *Baltimore Sun*, and *LA Times*; alternative media like the *Village Voice* and *Huffington Post*; and media outlets including major television networks, Cnet, and Bloomberg. Contributors include politicians, academics, representatives of major industry and advocacy groups, and journalists.

There is plenty of substantive content here, but capturing the original spirit of blogs, the serious content is peppered with fun, sometimes irreverent, informative posts such as the amusing 1958 Disney animated video *Magic Highways of the Future*, a picture primer of highway interchange configurations and their arcane names, and links to various humorous blog posts and photo galleries.

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between the NDE data and what we found the bridge decks' actual condition to be. Currently the research findings are under evaluation, and next steps are being considered."

Accurately assessing and monitoring the health of vital infrastructure can extend its life. By detecting deterioration early on, NDE findings give highway authorities the opportunity to intervene with timely corrective actions, making maintenance and management of their assets more effective and more economical. Larson believes NDE

could be very useful for detecting and fighting deterioration in Iowa's bridges.

ICMP started the Iowa project in June 2009. In July and early August, a team of six researchers and technicians—including two visiting researchers from BAM in Germany—spent a little more than three weeks inspecting, scanning, and gathering data on nine bridges throughout the state. Transferring some \$300,000 of NDE equipment halfway across the country, the team performed approximately 5,000 specific point



More on the web:

Read about CAIT's nondestructive evaluation program and research at cait.rutgers.edu/icmp or in the June and November 2009 issues of *Transportation Today*, available at cait.rutgers.edu/publications.



Ground-penetrating radar (above) surveys provide images of bridge decks that present an overall assessment of concrete deterioration. The Stepper (below) is a one-of-a-kind robotic device that simultaneously deploys multiple NDE technologies in one pass, in this case, impact echo and ultrasonic data. The Stepper can be expanded to incorporate other NDE technologies such as GPS, video, or radar to fill in data "gaps" other tools may not detect.



measurements on each bridge they evaluated.

Among the tools used were ground-penetrating radar (GPR) and air-coupled GPR, a portable seismic pavement analyzer, electrical resistivity and half-cell potential tests, and a one-of-a-kind robotic device coined "the Stepper" that gathers impact echo and ultrasonic data in one pass. In addition to gathering multiple types of data simultaneously, the Stepper automatically takes samples at controlled predefined intervals, allowing the tests to be done both quickly and accurately and freeing the researchers up to perform non-automated testing.

Each technology serves a specific purpose. For example, GPR surveys provide overall assessment of concrete deterioration. Impact echo accurately detects and characterizes delamination in the deck, a condition that occurs when corroding steel expands and weakens the concrete to the point of cracking. Half-cell potential and electrical resistivity tests provide information regarding the likelihood of various conditions and intensity of active corrosion. The portable seismic pavement analyzer helps NDE experts better understand the effects that deterioration processes and defects have on the mechanical properties of concrete. Dr. Nenad Gucunski, ICMP director and professor of civil engineering at Rutgers,

notes, "The most important thing is that using all these NDE technologies in concert has shown significant advantages in getting a comprehensive assessment of a concrete bridge deck's condition."

For all the impressive technology and equipment ICMP employs, the real art of NDE lies in how to understand and use the data. That's why at the end of the data-gathering phase, ICMP held a one-day workshop for the Iowa DOT, presenting the findings and giving an overview of NDE technologies available, principles of operation, field implementation, and data interpretation and analysis.

The workshop was followed up with a meeting of top engineers and administrators at the agency to discuss lessons learned. That in turn led to a discussion about moving toward implementation of NDE as a standard part of their bridge inspection protocol. Based on the sampling of Iowa's bridge inventory, ICMP recommended they adopt three technologies most suited to their particular network and problems: GPR, impact echo, and half-cell potential.

"Using [a variety of] NDE technologies in concert has shown significant advantages in getting a comprehensive assessment of a concrete bridge deck's condition."

Safety Takes a Front Seat

TSRC Earns National Honor for Plan4Safety

Red-light cameras. DUI checkpoints. Roadway improvements. These and other statewide enforcement efforts and engineering initiatives frequently make headline news, but how often do the intensive behind-the-scenes tools that drive the decisions for safety countermeasures get their moment in the spotlight?

The Roadway Safety Foundation (RSF) and Federal Highway Administration recently recognized the Transportation Safety Resource Center (TSRC) at Rutgers' CAIT for its efforts to reduce the incidence of crashes through an innovative and user-friendly crash data analysis program it developed, Plan4Safety, and for its role in revolutionizing the way enforcement and engineering groups analyze and use crash data. TSRC Program Manager Sarah Weissman accepted the honor at a formal awards ceremony hosted by the Federal Highway Administration that was held in Washington, D.C., on November 5, 2009.

A key champion of the software's development, Patricia Ott, director of Traffic Engineering and Safety (TES) at NJDOT, said the prestigious award is well deserved and a testament to TSRC's hard work and dedication to the cause of reducing roadway fatalities.

"[Plan4Safety] is the foundation of TSRC," says Ott, who traces the development of the software tool to the creation of TSRC itself. "When we set out to create the safety resource center, one of our mottos was: 'Safety starts with crash data.'

During the development phases of TSRC, it was decided that we needed an easier way to cultivate and analyze crash data ... and to provide county and local safety agencies with the same tools that [NJDOT] has access to."

That "easier way," Ott said, is Plan4Safety. Over the years, Ott's vision for a comprehensive crash analysis tool that instantly

pedestrian fatality issues. "We plan on taking a look at age factors. ... When we determine those factors, we can focus efforts toward that age group and get the message out to let them know they are at risk for fatal pedestrian crashes."

For Sergeant Whille, all too familiar are the days when enforcement campaigners had

Plan4Safety [has been recognized] for its role in revolutionizing the way enforcement and engineering groups analyze and use crash data.

filters years of criteria-based crash data, analyzes for crash hotspots within that data, outputs frequency of human and nonhuman crash factors, and performs other functions normally calculated over days and weeks by hand has come to fruition. Today, Plan4Safety helps professionals develop engineering improvements and focused enforcement efforts and plays an integral role in directly reaching the public and modifying adverse behaviors implicated in most crashes.

"We're going to ... change the culture of driving and the attitudes of people before they get in the car and make them safer drivers. Quite frankly, we're teaching proper driver etiquette through targeted education [made possible by P4S]," said Sergeant Timothy Whille, the administrative officer of the New Jersey State Police (NJSP) Operations Safety Bureau. This year, his department will use Plan4Safety to tackle ongoing

"no way to capture specific data." To him, the decision to use Plan4Safety's multitude of data collection and analysis functions is a necessary one.

"In the past, if there was a crash, we'd send a trooper to the scene, they'd do an investigation, and that was it. The data, though, is the most important thing—[with Plan4Safety] we can be proactive instead of reactive," he said.

Perhaps it's a trend that will soon spearhead traffic safety movements nationwide. Heading into its fifth year, Plan4Safety now has more than 500 users in state, county, and local agencies in New Jersey and is helping to plan data-driven traffic safety campaigns and budget-wise engineering improvements.

Sergeant Whille's optimistic vision of a safe future embodies the software creators' intent: "With Plan4Safety, this is just the beginning of what we can do. We've merely scratched the surface." ■



Sabine Kruschwitz, a visiting researcher from Germany, tests electrical resistivity of the concrete, an indicator that can be linked to rate of corrosion. Using multiple NDE tests helps give the most thorough "picture" possible.

NDE: What It Is and What It Does

NDE encompasses several techniques and tools used to collect and analyze the structural makeup and condition of bridges and other infrastructure. NDE can quantitatively assess the characteristics, quality, or sufficiency of structures by probing their physical or chemical properties.

Like a doctor uses X-rays or MRIs to detect broken bones or tumors, infrastructure professionals use NDE to see what is below the surface of a bridge or other structure. Also, as a doctor would use different diagnostic tools for different ailments, various NDE technologies measure different properties of the structure being examined. Some of these technologies include ground-penetrating radar (GPR), infrared thermography, and seismic, electromagnetic, and ultrasonic methods.

NDE is essential for collecting accurate condition and structural data. It can also spot potential issues before they are visible on the surface, so preventative measures can be taken before small problems become big ones.

NDE is often less costly, less disruptive, faster, and more accurate than traditional infrastructure testing methods. And, because NDE doesn't require extended lane closures, it can alleviate inconvenience to drivers as well. ■

Infrastructure on the Internet *continued from page 3*

Infrastructurist.com is edited by Melissa Lafsky, the former editor of the *New York Times* "Freakonomics" blog and former deputy web editor at *Discover* magazine.

recovery.gov

Recovery.gov is the U.S. government's official website providing easy access to data related to Recovery Act spending.

Recovery.gov went live shortly after President Obama signed the American Recovery and Reinvestment Act into law in February 2009. Recovery.gov's primary mandate is to allow taxpayers to see precisely what entities receive recovery money and how and where the money is spent.

The site displays easy-to-understand, user-friendly graphs, charts, and maps. These tools offer a telescopic national overview of recovery spending as well as microscopic views of individual projects in specific zip codes.

t4america.org

Transportation for America is a broad coalition of housing, business, environmental, public health, transportation, equitable development, and other organizations. The coalition seeks to align national, state, and local transportation policies with an array of issues like economic opportunity, climate change, energy, security, health, housing, and community development. These issues will play a key role in strengthening the foundation of our nation and give families and individuals greater and more appealing options. According to the site, "We're a campaign on the move, marshaling other like-minded groups and resources together to bring about a better vision of America for the 21st century ... by modernizing our infrastructure and building healthy communities where all people can live, work, and play."

la.streetsblog.org

La.streetsblog.org is a daily transportation blog and an umbrella to similar online publications throughout the country. The site's creators politically support alternative modes of transportation and are working to transform cities by reducing dependence on private automobiles and improving conditions for cyclists, pedestrians, and transit riders. ■



new to CAIT: staff ■ faculty

Andres Roda joined CAIT as of January 4, 2010, as an engineering research project manager for the New Jersey Local Technical Assistance Program (NJ LTAP). Roda is a licensed professional engineer in New Jersey and holds B.S. and M.S. degrees in civil engineering, both earned at Rutgers.

Roda's experience includes working in the public and private sectors, primarily on highway and bridge design. He is an active member of the American Society of Civil Engineers. His primary activities at CAIT will be providing technical engineering expertise to NJ LTAP stakeholders and participating in research initiatives in multiple strategic infrastructure areas at CAIT. ■



Matthew Klein Named Student of the Year



Every year, each of the 60 University Transportation Centers (UTCs) in the country selects an outstanding student whose achievements demonstrate the potential to make important future contributions in the transportation field. Students of the year are selected based on their technical merit and research, academic performance, professionalism, and leadership. This year, Matthew Klein is CAIT's UTC Student of the Year.

Klein is a master's of science candidate at the School of Engineering at Rutgers. His graduate thesis, *Structural Retrofitting to Increase Heat Resistance*, is on advanced materials and structures, primarily as they relate to transportation-related infrastructure. Klein's research includes examining ways to increase the lifespans of typical "workhorse" bridge superstructures and how to work toward building the "bridge of the future."

Klein's overall ambition is to bring new processes and materials to bridge building and design as well as provide efficient and cost-effective repair methods to existing structures. With these goals in mind, Klein's research focuses on reinforced concrete and composites and their integration into structural design and renovation. He also is involved with the FHWA Long-Term Bridge Performance (LTBP) program, which is being led by CAIT. His contributions to LTBP include investigating methods and materials that can increase bridge longevity and reduce maintenance costs. His research comprises real-world applications and testing that often involve high temperatures and tight spaces.

With this award, CAIT commends his outstanding academic performance, the technical merit of his research topic, and his service to the university community. Klein is originally from Northfield, Minnesota, and currently resides in Princeton, New Jersey. ■

Port Emergency Training Underway

CAIT's Laboratory for Port Security (LPS) was awarded a contract from the New Jersey Office of Homeland Security and Preparedness (NJOHSP) several months ago to train first responders in the event of a port emergency in the Delaware River and Bay region, which is a critical maritime infrastructure area in the United States. (See article in June 2009 issue of *Transportation Today* available at cait.rutgers.edu/publications.)

The South Jersey, Delaware River and Bay Area Port Awareness and Response Program includes 15 full-day workshops, to be held November 2009 through April 2010. The series is offered in Camden and Clayton, New Jersey. Serving the entire region, to date approximately 100 personnel from local, state, and federal agencies in New Jersey, Pennsylvania, and Delaware have participated.

Expert instructors are working professionals drawn from the U.S. Coast Guard, New Jersey State Police, U.S. Customs and Border Protection, and other organizations. Among topics covered in the training are port geog-



raphy and operations; local, state, and federal level regulatory agencies; threats, risks, and vulnerabilities; and response units and capabilities. NJOHSP issues certificates to those who complete the training, and EMS personnel receive Continuing Education Unit credits towards their licenses. ■

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Ali Maher, Ph.D., Director
Patrick Szary, Ph.D., Associate Director
Allison Thomas, Associate Director,
Marketing and Communications

For questions or comments about the newsletter, please contact:

Allison Thomas
a.thomas@rutgers.edu
732-445-0579, Ext. 113

Original photography: Nenad Gucunski, Nick Romanenko. **Contributing writers:** Janet Leli, Carissa Sestito.



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notable news: awards ■ recognition

Thomas Bennert, program manager for CAIT's Pavement Resource Program (PRP), was recently appointed to the **FHWA Technical Working Group (TWG)** on warm mix asphalt. The purpose of the group is to coordinate, develop, and provide national guidance and recommendations for the improvement of the warm mix asphalt program. The group will provide feedback as well as encourage correct use of warm mix asphalt technologies and address construction problems with current state-of-the-practice solutions. Bennert attended a TWG meeting from December 14–17, 2009, in Seattle, Washington.

Harold Neil Jr., CAIT Fellow and advisory board member for the Laboratory for Port Security (LPS), was appointed to **governor-elect Chris Christie's transition team for the New Jersey Office of Homeland Security and Preparedness (NJOHSP)**. The committee is providing the governor-elect with a review of the existing

office and recommendations regarding policies and structure of the organization, with a special focus on identifying waste or redundancy and potential savings to reduce the state's deficit. Neil was selected for the post as a transportation security expert and previous NJOHSP employee. The team's final report presented to the governor-elect is intended to serve as a blueprint for security practices and programs for New Jersey during Christie's term.

CAIT's **New Jersey Local Technical Assistance Program (NJ LTAP)** received an award from the New Jersey Chapter of the American Public Works Association (APWA) on November 19, 2009, at the annual chapter awards ceremony. New Jersey Chapter President Paul Wnek honored NJ LTAP with the **APWA 2009 Chapter Recognition Award**, citing the efforts made throughout the year in helping the chapter carry out its educational programs. NJ LTAP often

coordinates technical speakers, publicizes, and hosts educational seminars in partnership with APWA-NJ.

Claudia Knezek, program director of CAIT's Technology Transfer Group (TTG), received an **Excellence in Traffic Safety Award** and was made an honorary member of the New Jersey Police Traffic Officers Association.

CAIT congratulates **Lawrence Cullari Jr.**, **Federal Highway Administration-New Jersey Division** director of asset management, on receiving a **Superior Achievement Award**. This is the highest honor given by FHWA's administrator: "It recognizes the best of the best—individuals who through special acts, career accomplishments, or teamwork have exhibited leadership and commitment to excellence." The award ceremony was held in Washington, D.C., on October 29, 2009. ■

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Rutgers, The State University of New Jersey
100 Brett Road
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