engineering laboratory

Newsletter • Winter 2012

What's inside

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

A new year is upon us, with all of its challenges and rewards. I want to share some details of an exciting new focus area for NIST and EL.

NIST supports one of the key roles in the growth of the Smart Grid—bringing together manufacturers, consumers, energy providers, and regulators to develop "Interoperable standards." Responding to a mandate from Congress and the Administration, NIST developed the standards framework underpinning the nation's Smart Grid in less than two years. The standards foundation laid by NIST is helping ensure that the $4.5 billion of federal Smart Grid investments provided by the American Reinvestment and Recovery Act will provide efficient, reliable and resilient electric power to the Nation for decades to come.

In other words, NIST is responsible for making sure the many pieces of "the world's largest and most complex machine" are able to work together. I am pleased to report that Smart Grid is now officially part of the NIST Engineering Laboratory (EL).

In addition to Smart Grid, EL conducts research in smart manufacturing, smart buildings, and to some extent, smart transportation. The synergies between these domains have caused the Laboratory to focus on the broader world of new smart systems, called cyber-physical systems (CPS). CPS are networked physical, computer and biological technologies. Smart vehicles, buildings, electric grids and manufactured products that combine IT and physical technologies into interactive, self-fixing systems are transforming industries. Industry is also exploring "smart infrastructure" technologies, such as smart grid for water and a natural gas grid.

NIST research helps industry ensure that the systems are safe, secure and resilient. By developing standards, test methods and measurement tools, NIST can help U.S. industry accelerate development of innovative cyber-physical system products that create jobs, while also protecting these new types of CPS infrastructure from cyber threats.

EL is working closely with the NIST Information Technology Laboratory (ITL) and the Standards Coordination Office (SCO) to chart our course into this exciting area and is interacting with numerous external organizations. A short executive-level course in CPS was offered recently at NIST. A workshop will be held on March 13-14 in Chicago, titled "Foundations for Innovation in Cyber-Physical Systems." Finally, a roundtable of Chief Technology Officers is planned for the spring.

Please visit our website for more information on ongoing activities in the Laboratory: www.nist.gov/el/

Sincerely,

Dr. S. Shyam Sunder

Director, NIST Engineering Laboratory

CIB Presents: An International Workshop on Integrated Design & Delivery Solutions (IDDS)

This April, the National Institute for Standards & Technology (NIST) Engineering Laboratory (EL) will be hosting the Board of Directors of the International Council for Research and Innovation in Building and Construction (CIB) in Washington, DC. This will be one of only a few times in history that the United States has had the privilege of hosting this highly esteemed gathering of executives from international research organizations around the globe.

CIB was established in 1953 with help of the United Nations and holds a special UN Consultative Status. CIB has grown into a network that encompasses 500 organizations and 5000 individual experts in over 100 countries. Being part of this event will truly be a unique experience as it will bring executive leaders from around the world to share the work they are doing to advance IDDS across the globe.

NIST has invited its partners - FIATECH, Virginia Tech and A+CA – to host a one-day workshop, following the CIB Board meeting, to showcase the integrated design and delivery solutions that are being deployed by companies in the U.S. as well as abroad. This special one-day event will be held at the Westin hotel in Ballston, Virginia, during which presentations and discussions will cover three concentrated areas:

- Trends in emerging technologies and innovative practices (led by FIATECH),
- Research and education outputs (led by Virginia Tech), and
- Innovative design and delivery solutions (led by CIB's IDDS Team).

Come to See These World-Class Speakers

Carole Le Gall, Chief Executive Director of the CSTB, will provide her insights into French and European developments regarding the delivery of BIM-based applications and services. Dick Schmidt, the Director of Build Environment at TNO, one of the largest European contract research organizations, will speak about the impact of Building Information Modeling in the Netherlands. Prof. Keith Hampson, CEO of the Sustainable Built Environment National Research Centre, will provide a retrospective and prospective analysis of BIM in Australia. Rounding out IDDS as a concept, various aspects of project delivery will be discussed by Dr. Michael Garvin from the Myers-Lawson School of Construction at Virginia Tech.

Glenn Ballard (MBA, Ph.D), Associate Adjunct Professor in the Project Engineering and Management Program at the University of California, will pose the question "Should project budgets be based on worth or cost?" Dr. Raymond Levitt, Kumagai Professor of Engineering and Coordinator of the Construction Graduate Program at Stanford University will discuss ongoing research to develop a unifying framework regarding project governance. Phillip G. Bernstein, Vice President at Autodesk, will present BIM as a platform for global AEC change. Chuck Eastman, an originator of BIM concepts and Director of the Digital Building Lab in the College of Architecture at Georgia Tech, will perform the final address for the day by addressing the future of Industry Foundation Classes (IFC).

Join Us for Tours of the National Institute of Standards and Technology (NIST)

In addition, on April 19, workshop participants are invited to participate in a half-day of tours at the National Institute of Standards and Technology, in Gaithersburg, Md., that will highlight exciting research in the areas of energy, fire, materials, and nanotechnology. The tours will take place beginning at 9:30 a.m. Attendees will be able to register for tours when they register for the workshop. Registration for NIST tours must be completed no later than 5pm Monday, April 16, 2012.

We are inviting you, along with stakeholders in the architectural, engineering, construction and facilities management industry, to be part of this workshop. You may register to attend the workshop, sign up for the NIST tour, and make your hotel reservations from the following website: http://www.nist.gov/el/cib.cfm.

Double Jeopardy: Building Codes may Underestimate Risks due to Multiple Hazards

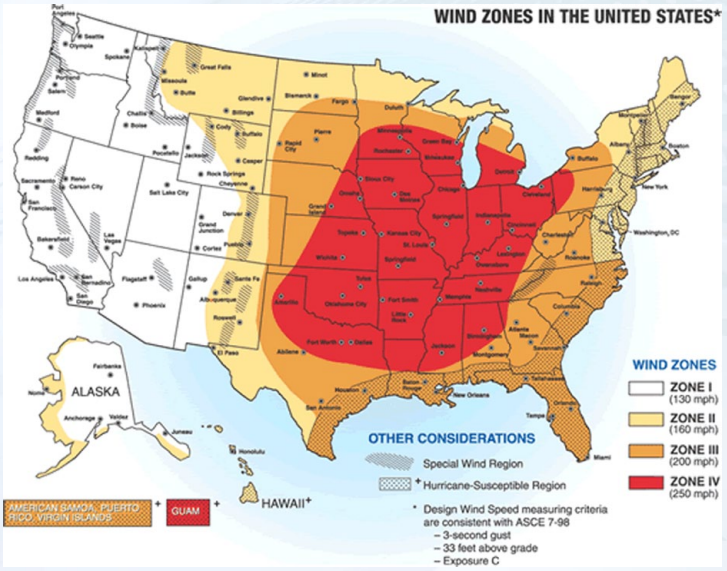
As large parts of the nation recover from nature's one-two punch—an earthquake followed by Hurricane Irene—building researchers from the National Institute of Standards and Technology (NIST) warn that a double whammy of seismic and wind hazards can increase the risk of structural damage to as much as twice the level implied in building codes.

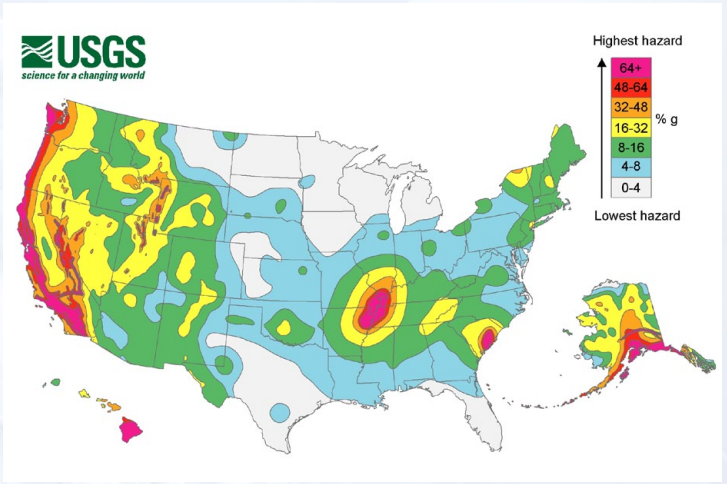
This is because current codes consider natural hazards individually, explains NIST's Dat Duthinh, a research structural engineer. So, if earthquakes rank as the top threat in a particular area, local codes require buildings to withstand a specified seismic load. In contrast, if hurricanes or tornadoes are the chief hazard, homes and buildings must be designed to resist loads up to an established maximum wind speed.

In a timely article published in the Journal of Structural Engineering,* Duthinh, NIST Fellow Emil Simiu and Chiara Crosti (now at the University of Rome) challenge this compartmentalized approach. They show that in areas prone to both seismic and wind hazards, such as South Carolina, the risk that design limits will be exceeded can be as much as twice the risk in regions where only one hazard occurs, even accounting for the fact that these multiple hazards almost never occur simultaneously. As a consequence, buildings designed to meet code requirements in these double-jeopardy locations "do not necessarily achieve the level of safety implied," the researchers write.

Simiu explains by analogy: a motorcycle racer who takes on a second job as a high-wire performer. "By adding this new occupation, the racer increases his risk of injury, even though the timing and nature of the injuries sustained in a motorcycle accident or in a high-wire mishap may differ," he says. "Understandably, an insurer would raise the premium on a personal injury policy to account for the higher level of risk."

The researchers developed a method to assess risks due to wind and earthquakes using a common metric of structural resistance. With a consistent measure (the maximum lateral deflection), the combined risk of failure can be compared to the risk that design limits will be exceeded in regions vulnerable to only one of the hazards, the basis for safety requirements specified in current building codes.





Top: Wind zone map shows how the frequency and strength of extreme windstorms vary across the United States. Wind speeds in Zone IV (red), where the risk of extreme windstorms is greatest, can be as high as 250 miles per hour.

Bottom: National seismic hazards maps display earthquake ground motions for various probability levels across the United States. These maps are the basis for seismic design provisions of building codes, insurance rate structures, and land-use planning.

Credit: (Top) Federal Emergency Management Agency, (Bottom) U.S. Geological Survey

* C. Crosti, D. Duthinh and E. Simiu. Risk consistency and synergy in multi-hazard design. ASCE Journal of Structural Engineering. Vol. 3, No. 8, Aug. 2011

They demonstrate their approach on three different configurations of a 10-story steel-frame building. One of the configurations used so-called reduced beam sections (RBS) to connect girders to columns. RBS technology was developed after California's Northridge earthquake in 1994, which resulted in significant structural damage in new and old buildings due to unanticipated brittle fractures in frame connections. Shaped like a dog bone, tapered RBS connections made the frames more ductile—better able to deflect without breaking.

In this case study, the researchers found that RBS connections do not decrease the risk that a steel-frame building will exceed its design limit when used in a region exposed to high winds or a region exposed to high winds and earthquakes. Consequently, the risk of failure doubled under dual-hazard conditions, when those conditions are of similar severity. However, they note that RBS connections can decrease the risk that limits associated with seismic design will be exceeded during the structure's life.

The researchers are continuing to extend their methodology and are proposing modifications to building codes.

U.S., Europe Collaborating on Smart Grid Standards Development

The U.S. Commerce Department's National Institute of Standards and Technology (NIST) and the European Union's (EU) Smart Grid Coordination Group (SG-CG) intend to work together on Smart Grid standards development, emphasizing common goals and areas of focus.

Both NIST and the SG-CG have mandates to coordinate the development of a standards framework for Smart Grids, which can unlock innovation in the electrical sector. The two organizations outlined areas for future collaboration in a joint white paper. The SG-CG represents three private-sector standards organizations: the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI).*

Smart Grids are next-generation electrical grids that attempt to predict and intelligently respond to the behavior and actions of all electric power users connected to it—suppliers, consumers and those that do both—in order to efficiently deliver reliable, economical and sustainable electricity services. The new collaboration is meant to ensure that Smart Grid standards on both continents have as much in common as possible, so that devices and systems that interact with these grids can be designed in similar fashion.

"While the potential benefits of Smart Grids are enormous, they can only be fully reached if we can all agree on global solutions," says Ralph Sporer, chairman of SG-CG. "It is promising to see that NIST and SG-CG will be supporting a number of common positions and areas of collaboration to ensure a consistent set of international standards."

Smart Grids are expected to ease the incorporation of renewable energy sources, energy saving devices and electric vehicles into the power system. Overall goals include the reduction of carbon emissions and security of supply. To promote this transformation, governments on both sides of the Atlantic have taken a number of actions in recent years, including the U.S. Energy Independence and Security Act of 2007 and the American Recovery and Reinvestment Act of 2009, and Europe's Directives 2009/72/EC and 2009/73/EC within the framework of the 3rd Package for the Internal Energy Market. This legislative effort has translated into a number of standards initiatives like the NIST Framework and Roadmap for Smart Grid Interoperability Standards in the United States and a Smart Grid mandate in the EU.

The collaboration aims to harmonize these conceptual frameworks. It also will promote the regular exchange of information regarding such issues as:

- Legislation, regulation and other policies underpinning NIST and SG-CG work

* Further information about CEN is available at http://www.cen.eu/cen/AboutUs/Pages/default.aspx; about CENELEC, at http://www.cenelec.eu/aboutcenelec/whoweare/index.html; and about ETSI, at http://www.etsi.org/WebSite/AboutETSI/AboutEtsi.aspx.

- Respective work methods, work programs and time lines
- Standardization deliverables
- Testing and certification frameworks
- Cybersecurity requirements and technologies

According to NIST's George Arnold, the National Coordinator for Smart Grid Interoperability in the United States, the many facets of Smart Grid development—spanning multiple sectors of the economy and a wide range of stakeholders—make the standardization effort anything but business as usual, but this collaboration will advance efforts in the long run.

"The need for integration of multiple technologies, the many international activities, and ever-changing technical solutions within a short time frame make standards development a challenging task for standards organizations worldwide," says Arnold, "But this collaboration should help make sure that no one reinvents the wheel."

Arnold adds that NIST's Smart Grid Interoperability Panel (SGIP) plans to draft a letter of intent outlining the specifics of the collaboration in the near future. The White Paper of NIST and SG-CG on Standardization of Smart Grids is available online at www.nist.gov//smartgrid/upload/eu-us-smartgrids-white-paper.pdf.

In Unique Fire Tests, Outdoor Decks will be Under Firebrand Attack

The National Institute of Standards and Technology (NIST) will unleash its Dragon—a NIST invention that bellows showers of glowing embers, or firebrands—at a unique wind tunnel test facility in Japan, where researchers will evaluate the vulnerability of outdoor deck assemblies and materials to ignition during wildfires, a growing peril that accounts for half of the nation's 10 most costly fires.

In a new report,* NIST researchers summarize suggestions for test designs and objectives offered by experts at a recent workshop convened in Los Angeles, Calif., with support from the U.S. Department of Homeland Security and input from the Office of the California State Fire Marshal. This input is now being formalized into plans for experiments that will be conducted in early 2012 at Japan's Building Research Institute (BRI) in Tsukuba.

There, NIST and Japanese researchers have merged two technologies, NIST's Firebrand Generator (the "Dragon") and BRI's Fire Research Wind Tunnel Facility, which is devoted to studies of how wind influences fire. The combination gives them the singular capability to replicate a firebrand attack and expose structures to wind-driven showers of embers under experimentally controlled conditions.

NIST's Firebrand Generator generates burning embers (or firebrands) that are major sources of ignition of house fires during blazes at the wildland-urban interface (WUI). Photo credit: NIST

* S.L. Manzello and S. Suzuki. Summary of the 2011 Workshop on Research Needs for Full Scale Testing to Determine Vulnerabilities of Decking Assemblies to Ignition by Firebrand Showers. NIST Special Publication 1129, Aug. 2011.

The brain child of mechanical engineer Samuel Manzello, the NIST Dragon is a two-meter tall, goose-neck-shaped stove pipe that breathes in wood chips and exhales firebrands at a controlled rate. Manzello created the Dragon to support NIST's program to better understand and prevent fires at the wildland-urban interface (WUI), with the ultimate aim of reducing property damage and human casualties.

Firebrands, or embers, are generated as vegetation and structures burn in WUI fires. Post-fire damage studies have suggested for some time that firebrands are a significant cause of structure ignition in WUI fires. However, prior firebrand research has focused on how far firebrands fly, known as spotting distance, and has not yielded definitive results to guide development of building codes and standards.

In 2005, NIST began the cooperative research effort with BRI that ultimately led to the NIST Dragon becoming a permanent resident at BRI. NIST and BRI have used the combined facility to study the vulnerability of siding treatments, window glazing assemblies, and overhanging eaves to ignition during realistic firebrand showers. Results are shared with standards and regulatory bodies, insurers, and trade associations to inform their decisions on material and building requirements.

Another study examined the effectiveness of the standard wire mesh used to cover building vents on houses. Manzello and his team determined that the 6-millimeter (1/4-inch) spacing required in building codes were too porous to, and did not, prevent firebrands from igniting materials placed behind the mesh. Consequently, the California Code of Regulations was recently amended to require significantly smaller mesh sizes to cover vent openings.

Now, deck assemblies are slated to come under firebrand assaults from the NIST Dragon. Post-fire surveys conducted by NIST have documented that decks are vulnerable to ignition during wind-driven firebrand showers. However, codes and standards for decks have not been devised with detailed knowledge of the threat.

For example, in California, where wildland fires are an annual threat to many communities, the State Fire Marshal adapted an ASTM fire test designed for roofing materials to determine the response of deck materials to firebrand showers. The test entails placing a burning crib on top of a test deck and monitoring physical changes for a set period.

"It's assumed that this test represents a worst-case firebrand shower scenario," Manzello explains, "but no one knows for sure. The test does not simulate dynamic firebrand attack during a real wildland-urban interface fire. We are designing our full-scale tests to quantify the vulnerabilities and provide the basis for improvements in building codes."

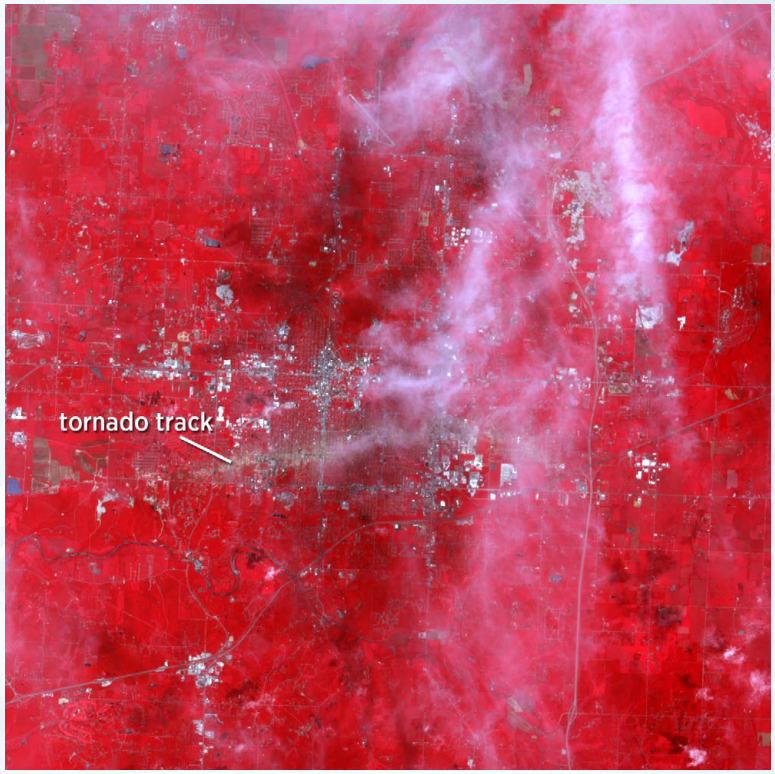
NIST Seeks Help in Understanding Public Response to Joplin Tornado

As part of its technical study on the impacts of the devastating May 22, 2011, tornado that struck Joplin, Mo., the National Institute of Standards and Technology (NIST) will be conducting interviews in the Joplin area with survivors and the families and friends of victims from Oct. 14 - Dec. 1, 2011. The interviews will be designed to obtain information about what individuals saw, heard, felt and did before, during and after the tornado to better understand how people within the warning area responded.

The interviews will help NIST determine the behavior and fate of individuals, both those who survived and those who did not, by collecting and analyzing information on injuries and fatalities, human behavior, situation awareness, and emergency communications before and during the Joplin tornado.

Anyone wishing to participate in the NIST interviews should call (240) 780-6701, or contact contractor Jennifer Spinney at jspinney@rogers.com or NIST researcher Erica Kuligowski at erica.kuligowski@nist.gov. Interviews can be conducted by phone anytime during the Oct. 14 - Dec. 1, 2011, period, or in person when the interviewers will be in Joplin from Oct. 21 – 31, 2011.

The massive tornado in Joplin was rated category EF5, the most powerful on the Enhanced Fujita scale. According to the National Weather Service (NWS) and the Federal Emergency Management Agency (FEMA), the multiple-vortex storm impacted an area approximately three-quarters of a mile wide by 22 miles long, destroyed or damaged some 8,000 structures in its path, and killed more than 150 people. This makes it the single deadliest tornado in the United States in the 61 years that official records have been kept.



False-color satellite image showing the 22-mile track of the tornado that struck Joplin, Mo., on May 22, 2011.

Credit: NASA's Terra satellite

From May 25-28, 2011, NIST sent four engineers to Joplin to conduct a preliminary reconnaissance of building performance and emergency communications during the tornado. Based on the analysis of the data collected and other criteria required by regulation, the NIST Director established a research team under the National Construction Safety Team Act to proceed with a more comprehensive study of the impacts of the disaster.

Along with the previously stated aim of better understanding public response and behavior, the other objectives of the NIST technical study are to:

- determine the characteristics of the wind hazard from the tornado;
- determine the performance of residential, commercial and critical (police stations, firehouses, hospitals, etc.) buildings;
- determine the performance of lifelines (natural gas, electrical distribution, water, communications, etc.) as they relate to maintaining building operation; and
- make recommendations, if warranted, for improvements to building codes, standards and practices based on the findings of the study.

For more information on the NIST Joplin tornado study, go to www.nist.gov/el/disasterstudies/weather/joplin-072511.cfm.

NIST Names 10 to National Construction Safety Team Advisory Committee

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Ten prominent building and fire experts have been appointed by Patrick Gallagher, director of the National Institute of Standards and Technology (NIST), to serve on the National Construction Safety Team (NCST) Advisory Committee. The committee, first established in 2003, advises the NIST director and relevant staff on studies of building failures and associated evacuation and emergency response procedures conducted under the authorities of the NCST Act (Public Law 107-231). This includes guidance on the composition and function of investigation teams and other responsibilities under the act.

The committee is being reestablished with new members serving staggered terms as required by its charter. The original group that served from 2003 to 2008 was focused heavily on NIST's investigation of the collapses of three buildings at New York's World Trade Center complex on 9/11.

The new NCST Advisory Committee members serving a one-year term are:

- Carlos Fernandez-Pello, professor, Department of Mechanical Engineering, University of California Berkeley (Berkeley, Calif.)
- Susan Cutter, distinguished professor and director, Hazards and Vulnerability Research Institute, University of South Carolina (Columbia, S.C.)
- Jeffrey Garrett, president and CEO, CTL Group (Skokie, Ill.)

Members serving a two-year term are:

- Ron Coleman, chairman, Board of Trustees, Commission on Fire Accreditation International (Elk Grove, Calif.)
- Anne Kiremidijian, professor, Department of Civil and Environmental Engineering, Stanford University (Stanford, Calif.)
- Sarah A. Rice, project manager, Preview Group Inc. (Cincinnati, Ohio)

Members serving a three-year term are:

- Paul A Croce, retired VP and manager of research, FM Global (Middletown, R.I.)
- Jeremy Isenberg, senior principal, Specialty Practices Group, AECOM (Oakland, Calif.)
- R. Shankar Nair, principal and senior VP, Teng & Associates Inc. (Chicago, Ill.)
- James R. Quiter, principal, Arup (Walnut Creek, Calif.)

Members were selected on the basis of their technical expertise and experience, records of distinguished professional service, and knowledge of issues affecting teams established under the NCST Act.

Under the NCST Act, NIST is responsible for conducting investigations of the events leading to building failures and associated evacuation and emergency response procedures that result in substantial loss of life or pose the potential for substantial loss of life. The NIST investigations establish the likely technical causes of the building failures and evaluate the technical aspects of emergency response and evacuation procedures in the wake of disasters, such as blasts, earthquakes, fires, impacts and windstorms, or while the building is in service or under construction. The goal is to recommend improvements to the way in which buildings are designed, constructed, maintained and used.

The new NCST Advisory Committee will hold its first meeting on Nov. 7, 2011, at NIST headquarters in Gaithersburg, Md. The meeting is open to the public. Details will be posted in an upcoming notice in the Federal Register (www.gpoaccess.gov/fr).

More information about the NCST Act and the NCST Advisory Committee may be found at http://www.nist.gov/el/disasterstudies/ncst/index.cfm. For background on NIST's more than 40 years of experience studying structural failures and fires, go to the web pages of the NIST Disaster and Failures Studies Program at www.nist.gov/el/disasterstudies.

New Report Urges More Detailed Utility Metering to Improve Building Efficiency

A new interagency report recommends systematic consideration of new metering technologies, called submetering, that can yield up-to-date, finely grained snapshots of energy and water usage in commercial and residential buildings to guide efficiency improvements and capture the advantages of a modernized electric power grid.

Commercial and residential buildings consume vast amounts of energy, water, and material resources. In fact, U.S. buildings account for more than 40 percent of total U.S. energy consumption, including 72 percent of electricity use. If current trends continue, buildings worldwide will be the largest consumer of global energy by 2025. By 2050, buildings are likely to use as much energy as the transportation and industrial sectors combined.

Submetering is the use of metering devices to measure actual energy or water consumption at points downstream from the primary utility meter on a campus or building. Submetering allows building owners to monitor energy or water usage for individual tenants, departments, pieces of equipment or other loads to account for their specific usage. Submetering technologies enable building owners to optimize design and retrofit strategies to energy and water management procedures more efficient and effective.

While the return on investment (ROI) for submeters depends on specific energy-efficiency strategies that may vary by climate, building type, and other factors, "numerous case studies provide evidence that the ROI can be significant," concludes the report,Submetering of Building Energy and Water Usage: Analysis and Recommendations of the Subcommittee on Buildings Technology Research and Development. Installing submetering technology also makes possible the use of more advanced conservation technologies in the future, the report notes.

The report is a product of the Buildings Technology Research and Development Subcommittee of the National Science and Technology Council (NSTC), a cabinet-level council that is the principal means within the executive branch to coordinate science and technology policy across the diverse entities that make up the federal research and development enterprise.

The NSTC report provides an overview of the key elements of submetering and associated energy management systems to foster understanding of associated benefits and complexities. It documents the current state of submetering and provides relevant case studies and preliminary findings relating to submetering system costs and ROI. The report also addresses gaps, challenges and barriers to widespread acceptance along with descriptive candidate areas where additional development or progress is required. It also surveys policy options for changing current buildings-sector practices.

The 74-page report can be downloaded from: www.bfrl.nist.gov/buildingtechnology/documents/SubmeteringEnergyWaterUsageOct2011.pdf For more details, see the Nov. 8, 2011 announcement, "Government Issues Building Energy and Water Submetering Report" at www.nist.gov/el/submetering.cfm.

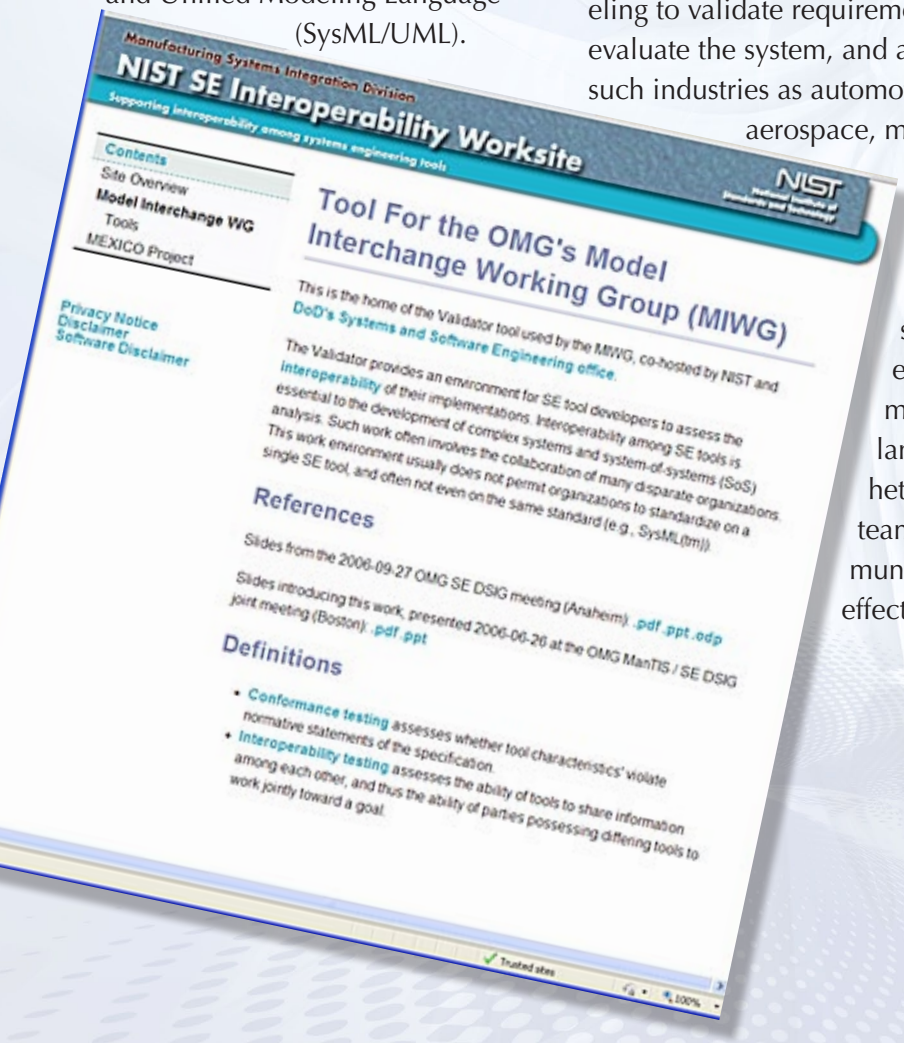
Shutterstock / Bob Keenan

Key Manufacturing Technology Furthers Systems Integration

Peter Denno of the Engineering Laboratory at the National Institute of Standards and Technology provided key enabling technology for the Object Management Group's (OMG) Model Interchange Working Group (MIWG) , a major step in ensuring reliable interchange of engineering models based on OMG technology. The MIWG's work over the past 2 years resolved many impediments to interoperability, resulting in a test suite for tool vendors and users to ensure reliable interchange of models based on the Systems Engineering Modeling Language and Unified Modeling Language (SysML/UML).

Mr. Denno developed the NIST Validator which processes computer-interpretable specifications of those standards and configures itself for assessing conformance. The Validator provides an interface accessible to anyone on the web, for uploading models and immediate analysis. Public release of the MIWG test suite enables vendors and users of tools based on OMG technology to investigate for themselves interoperability concerns they may have with the modeling tools they use or develop.

Systems engineering relies on modeling to validate requirements or evaluate the system, and applies to such industries as automotive, rail, aerospace, military, and energy. SysML provides a single systems engineering modeling language for heterogeneous teams to communicate more effectively.



"The MIWG has demonstrated our OMG standards compliance and directly benefited our customers and partners with improved model interchange for more design flexibility. We are pleased to publish these test results to help organizations assess model interchange."

Reported Atego, IBM, NoMagic, Sodius (supporting IBM Rhapsody), SOFTEAM, and Sparx Systems

More information can be obtained from the NIST Validator Site http://www.nist.gov/el/msid/miwg.cfm and the MIWG Test Suite Wiki http://www.omgwiki.org/model-interchange/doku.php.

Manufacturing Research Enables Development of a Handheld Blood Meter Prototype

Researchers from ACTA Technology (Boulder, CO) are developing a hand-held point-of-care and home-use test for measuring blood coagulation that uses a drop of whole blood taken by a finger prick. Unlike clinical devices currently on the market, which use optical analysis, cantilevers, or chemical reactions, their approach uses micro-electro-mechanical sensors that incorporate a parallel plate to measure the blood clotting time. Based on micro/nano technology developed by Nicholas Dagalakis of the NIST Engineering Laboratory, the device tests a small amount of whole blood, making it less intrusive so it can be used at home or in a doctor's office without the need for a laboratory.

The prothrombin time test works by introducing a tissue factor to begin the series of reactions that occur when a blood vessel is ruptured. The clot changes the blood from a free-flowing solution to a gel-like substance and it is this change that the sensor monitors and detects.

Various medical conditions require the use of the anti-coagulant warfarin, a powerful but potentially dangerous drug. Affected patients need their clotting time monitored to ensure proper drug dosing. ACTA's device has been demonstrated to measure the rheometric properties of complex fluids similar to blood in seconds using nanoliter size samples.

Edward Clancy, ACTA's Chief Technical Officer, also credits NIST staff from the CNST NanoFab for his company's ability to rapidly develop prototypes. "We built our entire sensor device in the NanoFab, everything from the mask writing to the ion etching to the deposition of our gold contacts," says Clancy, "Now that we have the processes optimized, we can go to a fabrication shop in the U.S. for mass production." According to Clancy, "a small company cannot do this ourselves, and it is hard to get commercial fabs to produce small quantities for prototyping."

Medicare recently announced expanded coverage for warfarin patients, including monitoring clotting time at home. Thirty million Americans take warfarin, a number that will grow as more people use blood thinners to reduce the risk of heart attacks and strokes. Clancy believes that ACTA is well positioned to see its product widely adapted as home blood testing becomes more common.

ACTA Technology, a science-based company that focuses on nanotechnology, carries a research license from NIST for US Patent 6484602, Six-Degree of Freedom Micro-Positioner.

Study Finds Failure Points in Firefighter Protective Equipment

In fire experiments conducted in uniformly furnished, but vacant Chicago-area townhouses, National Institute of Standards and Technology (NIST) researchers uncovered temperature and heat-flow conditions that can seriously damage facepiece lenses on standard firefighter breathing equipment, a potential contributing factor for first-responder fatalities and injuries.

The findings are detailed in a report* from a research study sponsored by the U.S. Fire Administration and Department of Homeland Security. The work is an important step toward improving what may be the most vulnerable component of a firefighter's protective gear in high-heat conditions: the facepiece lenses of the so-called self-contained breathing apparatus, or SCBA.

Failure of the lens can expose a firefighter to toxic gases and can result in burns to the respiratory tract as well as asphyxiation. In several SCBA-related deaths, degraded masks were found affixed to the faces of victims while their equipment continued to supply air.

In two of four realistic living-room fire scenarios tested by NIST, "lenses exhibited bubbling and loss of visual acuity, as well as severe deformation, and, in one case, a hole," the NIST team says.

The researchers tested five models of SCBA facepieces, each from a different manufacturer. In all cases of lens degradation, the damage was due to temperatures and heat fluxes that exceeded performance limits of polycarbonate, the lens material commonly used in SCBA for fire fighters.

"Our results do not suggest, in any way, that that lens failures are due to the manufacturers," explains NIST's Nelson Bryner, a co-author of the report. "All the lenses tested were consistent with requirements specified in standards."

In the United States, SCBA makers must submit their products for certification testing before they can be sold. Certification requires passing the "heat and flame test" specified in a standard by the National Fire Protection Association. Citing the conclusions of other researchers, the NIST team notes that this test is conducted at high temperatures, but "it does not capture the conditions of temperature, heat flux and duration that a firefighter might experience."

The townhouse fire experiments will inform efforts to improve the match between standard requirements and real-life conditions. Until now, these efforts have been hampered by lack of information regarding the high-temperature and high-heat-flow performance of polycarbonate lenses and the actual fire-scene conditions that have resulted in lens failures.

Flames from a living-room pour out the front door of a townhouse in NIST tests that studied conditions that can result in the failure of the facepiece lens of the self-contained breathing apparatus worn by firefighters. Facepieces were outfitted with devices to record temperatures and then mounted on a headform test stand placed outside doorway. The foil-wrapped equipment to the right of test set-up measured thermal heat flux. Credit: NIST

The NIST experiments were conducted in two-story townhouses in Bensenville, a suburb northwest of Chicago, in cooperation with the Bensenville and Chicago Fire Departments and the Bureau of Alcohol, Tobacco and Firearms. In each of the four "furnished-house experiments," the conditions were nearly identical, save for the location of polyurethane heads outfitted with a SCBA facepiece and controlled variations in fire exposure conditions, adjusted, for example, by opening and closing of doors and windows at specified times.

* A Mensch, G Braga and N Bryner, Fire Exposures of Fire Fighter Self-Contained Breathing Apparatus Facepiece Lenses. NIST Technical Note 1724, Nov. 2011. The report can be accessed at www.nist.gov/manuscript-publication-search.cfm?pub_id=909917.

Rooms were equipped with devices to record temperatures rapidly at regular intervals between ceiling and floor. Facepieces also were equipped with sensors, on the inside and the outside of the lenses and in the immediately surrounding space. A gauge to measure heat flow, or flux, was positioned next to the facepieces.

The most devastating damage occurred in a scenario akin to one in which a firefighter would enter a burning living room from a front porch. The living room fire smoldered for five minutes after ignition. Opening the front door literally breathed life into the smoldering fire. The rush of heat from the now blazing living room transformed a relatively cool environment on the porch into an inferno. The SCBA lens's exterior surface temperature reached 280 degrees Celsius (536 degrees Fahrenheit), about the midpoint of the range of published polycarbonate melt temperatures. The lens developed a significant hole, according to the NIST report.

"The next step," the NIST researchers write, "is to identify the exposure limit just before thermal degradation occurs. Data on the limits of the equipment would be valuable information for the fire service to help prevent further injuries and fatalities related to SCBA equipment failure."

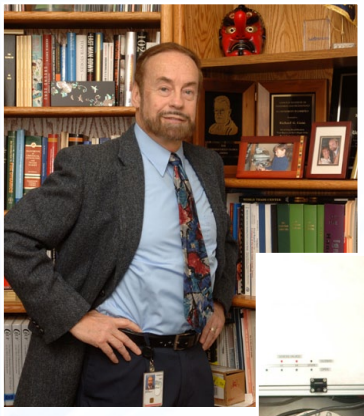
EL Researcher Honored by Life-Cycle Assessment (LCA) Community

The highest honor awarded by the American Center for Life Cycle Assessment (ACLCA) recognizes an individual for their long-term support of the LCA community. At its annual 2011 conference in Chicago in October, EL researcher Barbara Lippiatt earned this distinction. ACLCA is a non-profit membership organization that seeks to build capacity and knowledge of Environmental LCA among industry, government and non-governmental organizations. In presenting the award, ACLCA President Rita Schenck spoke of the sustained contributions Barbara has made since 1994 to bring LCA research into practice through development of the Building for Environmental and Economic Sustainability (BEES) software. Aimed at designers, builders, and product manufacturers, the tool evaluates the life-cycle environmental and economic performance of building products. The online version of BEES has been accessed about 40,000 times since its release in February 2011.

Staff Awards

Dr. Dick Gann

Senior Research Scientist, Fire Research Division



The Presidential Distinguished Rank Award

This award is the highest honor given to a senior executive or senior professional in the federal government.

Mr. Bob Zarr

Mechanical Engineer, Energy and Environment Division

Thermal Conductivity Award

This award is the highest award given by the International Thermal Conductivity Conference for his significant contributions to the field.

Dr. Vijay Srinivasan

Division Chief, Systems Integration Division

Fellow of the American Association for the Advancement of Science (AAAS)

For distinguished contributions to scientific theory, algorithms, and standards for computer-aided design and manufacturing.

Dr. Fahim Sadek

Leader, Structures Group
Materials and Structural Systems Division

Selected to receive the ASCE Moisseff Award

Along with his co-authors Sherif El-Tawil and Yasser Alashker for their paper entitled, "Progressive Collapse Resistance of Steel-Concrete Composite Floors."

Dr. George Arnold

Director, Smart Grid and Cyber Physical Systems Program Office

Fellow of Institute of Electrical and Electronics Engineers (IEEE)

For leadership in architecture and protocols for the electric grid and telecommunication networks.

Structural Research Engineering Positions National Fire Research Laboratory (NFRL)

The National Fire Research Laboratory (NFRL) at NIST anticipates two position openings for research structural engineers in the near future. The research structural engineers will play a critical role in building a vibrant experimentally-driven research program on fire resistance of real-scale structures using the NFRL, a unique experimental facility nearing completion on the NIST Gaithersburg, MD campus. The research structural engineers will lead NIST's efforts in conceiving, safely conducting, and reporting on real-scale experimental research on steel, concrete, and composite (steel and concrete) structures exposed to simultaneous fire conditions and mechanical loads. The engineers will join NIST's world-class research team in Fire Science and Structural Performance under Multi-hazards. They will develop national and international collaborations and will actively participate in the development of relevant standards and codes, enabling a transformation to performance-based fire resistance design of concrete and steel structures. The research engineers will lead the development of an experimental database on the fire performance of large-scale structural connections, components, subassemblies, and systems, which will be used to validate physics-based models of structural fire performance and to foster innovation in design and construction.

NIST encourages outstanding structural engineers with experience in large-scale structural experimentation and a background in steel or concrete design and construction to contact jiann.yang@nist.gov. Additional information on the NFRL and fire research at NIST can be found at the following website: nist.gov/el/fire_research/nfrl.cfm
U.S. citizenship is required for employment at NIST. The Department of Commerce is an Equal Opportunity Employer.

All Federal vacancy announcements are listed on the USAJobs website: www.usajobs.com

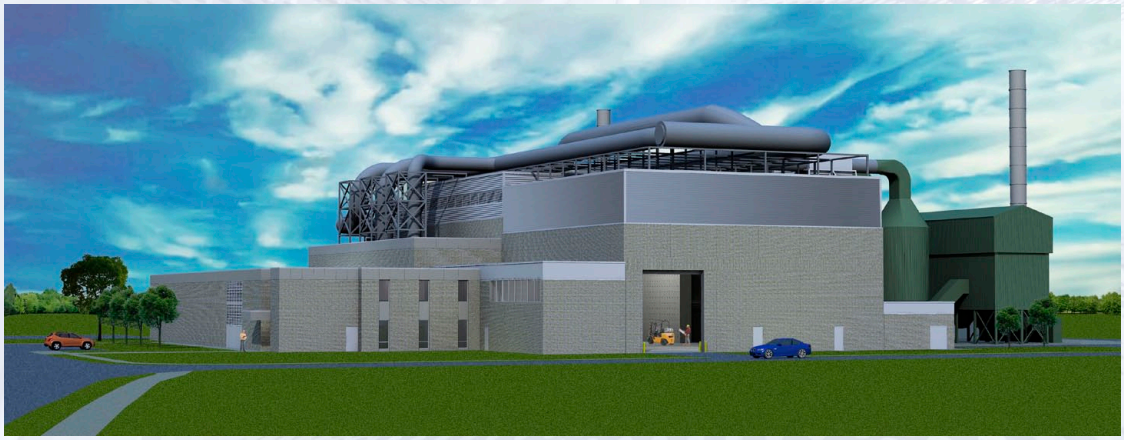
EL Grants

NIST is soliciting proposals for financial assistance for FY 2012 under a number of programs, including the Engineering Laboratory (EL) Grant Program and the Fire Research Grant Program.

For more information go to:
www.nist.gov/el/fire_grants.cfm
or
www.nist.gov/el/elgrants.cfm

Working with EL

For more details, please visit the EL Career website at www.nist.gov/el/careers.cfm



The new National Fire Research Laboratory (NFRL).

Recent Publications

- Experimental Study of the Three Dimensional Internal Structure of Underventilated Compartment Fires in an ISO 9705 Room.
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NIST Engineering Laboratory

Dr. S. Shyam Sunder, Director

Gail Crum, Executive Assistant to the Director

100 Bureau Drive, M/S 8600
Gaithersburg, Maryland 20899-8600
301-975-5900 Telephone
301-975-4032 Facsimile

www.nist.gov/el

el@nist.gov