engineering laboratory

Newsletter • Spring 2013

What's inside

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

In "The Budget Message of the President" that accompanied the Administration's FY2014 Budget to Congress, President Obama stated that the "Budget maintains a world-class commitment to science and research, targeting resources to those areas most likely to contribute directly to the creation of transformational technologies that can create the businesses and jobs of the future." Specifically, the budget requests an increase of $25 million in key areas of national priority led by the Engineering Laboratory: Cyber-Physical Systems (+$10M), Smart Manufacturing (+$10M), and Disaster Resilience Frameworks and Standards (+$5M). We have worked hard to plan these programs and are well positioned and ready to initiate work in partnership with our stakeholders once an appropriation is received.

In this issue of The Engineering Laboratory (EL) Newsletter, we focus on just a few of the great successes that the Lab has had over the last few months in support of industry and society.

On pages 2 and 14, you can read about our Smart Grid efforts, from NIST Director Pat Gallagher signing the official memorandum to privatize the Smart Grid Interoperability Panel with SGIP 2.0 Chair John McDonald to the Green Button initiative that provides energy consumers with electronic access to their energy usage data.

An engineer teaching a NIST robot how to handle packages delivered to a conveyor by an automated guided vehicle

Readers of the EL Newsletter will recall our move into Cyber-Physical Systems and those efforts have resulted in the publication of a trio of reports. Our efforts will accelerate with the arrival of Presidential Innovation Fellows in the coming months. You can read about these on pages 4-5.

On page 8, you can read about the world's first hazard scale for wildland fires that will accurately assess risk and allow communities to better resist the threat of fire through improved building codes, standards and practices.

Other articles will provide insight into our research efforts in fire, concrete, energy-efficiency, and U.S. manufacturing. Finally, you will see some awards, publications, and new appointments that illustrate the great work of our staff.

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

NIST-established Smart Grid Standards Group Reaches Key Milestone

NIST Director Pat Gallagher and SGIP 2.0 Chair John McDonald smile and shake hands after signing the official MOU with SGIP 2.0, solidifying the future relationship of NIST with the new organization.

Just like a proud parent showing off graduation pictures of a son or daughter, NIST leaders have recently been touting the growth and accomplishments of the Smart Grid Interoperability Panel (SGIP). The SGIP was established in December 2009 to support NIST in fulfilling its responsibility to coordinate standards development for the Smart Grid. Earlier this year, the SGIP took an important step in its development when it began operating as a self-sustaining not-for-profit legal entity, a move that NIST envisioned when it established the SGIP in 2009.

NIST has been involved in measurement research and standards development related to the electric grid for over a century (see History of Electrical Research at NIST). So when Congress established the Smart Grid as a national priority in the "Energy Independence and Security Act of 2007" (EISA), it was only fitting that NIST was tasked with a key assignment—"to coordinate development of a framework that includes protocols and model standards for information management to achieve interoperability of Smart Grid devices and systems."

"Smart Grid" refers to the modernized electric grid, now being developed, that uses information technology to deliver electricity efficiently, reliably, and securely. Unlike today's grid, which primarily delivers electricity in a one-way flow from generator to outlet, the Smart Grid will permit the two-way flow of both electricity and information.

The Smart Grid, which is really a "system of systems," will be a vast, interconnected network that includes everything from power plants and rooftop solar panels to electric substations and electric cars to smart refrigerators and dishwashers. Linking together so many individual systems and devices, each built in a specific time and place (across years and continents) by different manufacturers, is a daunting challenge. The goal of "interoperability" is to ensure the capability of two or more networks, systems, devices, applications, or components to exchange and readily use information—securely, effectively, and with little or no inconvenience to the user.

In order to achieve interoperability in such a complex ecosystem of manufacturers, consumers, energy providers, and regulators, leaders at NIST realized that they must develop a forum to bring these diverse stakeholders together. NIST's task took on added urgency and importance in early 2009 when President Obama identified and funded Smart Grid development as a key element of the "American Recovery and Reinvestment Act of 2009" (ARRA, commonly known as the Stimulus Act).

Throughout 2009, NIST organized a series of meetings and workshops that brought together business leaders and technical experts to identify key areas where standards coordination would be required to fill standards gaps, harmonize existing standards, and meet the new needs and opportunities made possible by the evolving Smart Grid. Late in 2009, NIST created the SGIP as the organization where this diverse group of stakeholders could come together to accomplish this important work.

With NIST providing funding to administer the organization and to accelerate its technical work, the SGIP quickly got to work. The membership of the SGIP grew to nearly 800 companies and organizations from 22 different stakeholder categories. Over the next three years, more than 30 groups of volunteer experts (called Committees, Priority Action Plans, and Domain Expert Working Groups) worked diligently to define use cases and requirements, hammer out differences, and reach consensus on Smart Grid standards that would help achieve interoperability. On any given day, three or four of these groups, ranging in size from five to

fifty members, would be meeting in conference calls, webinars, or face-to-face meetings. These groups established and maintained frequent interactions with the dozens of Standards Setting Organizations (SSOs) who were ultimately responsible for developing the specific standards. The entire process was based on openness and consensus, and a collaborative wiki was used to facilitate sharing and storing of information.

Within just a few months, the deliverables (such as new standards, guidelines, white papers, reports, etc.) started to flow. The work products were captured in the Interoperability Knowledge Base and the Catalog of Standards. The Catalog of Standards serves as a compendium of standards, practices, and guidelines considered relevant for the development and deployment of a robust and interoperable Smart Grid. The extensive information included for each entry in the Catalog of Standards is a very useful resource for utilities, manufacturers, regulators, consumers, and other Smart Grid stakeholders. Each standard included in the Catalog goes through an extensive review process and must be accepted by a supermajority of the SGIP voting members. As of February 1, the Catalog contains more than 50 standards or standards components.

Since the creation of SGIP in 2009, it has been the goal of NIST to support and nurture the organization until it matures enough to stand on its own. Throughout 2012, leaders from NIST and SGIP worked together to make that transition process a reality. And on December 4, 2012, NIST Director Patrick Gallagher and SGIP Governing Board Chair John McDonald, GE Digital Energy, signed a Memorandum of Understanding (MOU) that outlines how the two groups will partner and work together in the years ahead.

In recent weeks, SGIP 2.0, Inc. has begun operating independently, with nearly 100 organizations signed up—and paying dues—as founding members of the new organization.The day-to-day efforts of the many expert working groups within SGIP 2.0 continue unabated, and the Catalog of Standards will grow in the months ahead to include hundreds of Smart Grid-related standards. More details about SGIP 2.0's value proposition—and information on how to become a member—are available on its website, sgip.org.

Looking back at the past three years, George Arnold (Director, Smart Grid and Cyber Physical Systems Program Office, and National Coordinator for Smart Grid Interoperability) said, "The SGIP has been a remarkable success. It has empowered a standards coordination process that is broader, faster, and stronger. We've been able to make a great start on achieving our long-term goal of Smart Grid interoperability."

"The process, however, must continue for years to come as the Smart Grid evolves. We're delighted, therefore, that private industry has now been able to take over its proper role in our American standards process, which is built on industry-led, voluntary standards."

In addition to its standards coordination role, NIST's Smart Grid program performs vital research supporting the nation's electrical industry and infrastructure. Drawing on its scientific, technical, and engineering expertise, NIST characterizes and measures many of the critical elements that make up the Smart Grid. For more details about the NIST Smart Grid Program, please visit the website (www.nist.gov/smartgrid).

New Reports Define Strategic Vision, Propose R&D Priorities for Future Cyber-Physical Systems

If designed and built efficiently, flexibly and securely, next-generation cyber-physical systems (CPS) now sprouting from interconnections that join the digital and engineered physical worlds will deliver extraordinary capabilities and tremendous benefits on scales ranging from individuals to organizations and from industries to national and global economies.

Three new reports prepared for the National Institute of Standards and Technology (NIST) distill the perspectives of executives and technical experts from industry, academia and government on the "ifs" and the "what's next" of emerging intelligent systems-of-systems technologies. Complex technical, institutional and societal challenges notwithstanding, future CPS could have sweeping impacts on how we live, work and do business, according to the reports.

"CPS are enabling a new generation of 'smart systems'—and the economic impacts could be enormous," explains the summary report of a NIST-organized roundtable of industry and government executives and university leaders. "The disruptive technologies emerging from combining the cyber and physical worlds could provide an innovation engine for a broad range of U.S. industries, creating entirely new markets and platforms for growth."

CPS go well beyond today's "embedded systems," which are largely task-specific machines that operate under computer control. Anticipated CPS uses such as intelligent vehicles and highways and next-generation air transportation will be significantly more ambitious, diverse and integrated than those of today's task-specialized embedded systems.*

The broad sweep of anticipated CPS uses is suggested by a variety of other labels inspired by the convergence of networking and information processing technologies with engineered physical systems. Together, they create systems that integrate distributed networks of sensors, controls and processors—for example, "internet of things," "industrial internet" and "smarter planet."

The good news, according to the experts assembled by NIST, is that the United States, as the world leader in cutting-edge cyber technologies and engineered physical systems, is well-positioned to reap the competitive advantages of developing and mastering advanced CPS. But other nations are not conceding these advantages.

The European Union, for example, plans to invest $7 billion on embedded systems and CPS, with the aim of becoming a global leader in the field by 2020. Japan, which currently hosts the world's largest tradeshow on embedded systems, has similar ambitions.

Developed with input from about 80 experts in CPS and related technologies, the new reports provide a strategic vision and business drivers motivating concerted public-private

* For examples, see the Department of Transportation's Intelligent Transportation Systems Joint Program Office at www.its.dot.gov/ and its Federal Aviation Administration NextGen Program Office at http://www.faa.gov/nextgen/

efforts to achieve the unprecedented capabilities of next-generation CPS within the next two decades. They also provide a multilayered view of the research and development challenges that must be solved to realize this potential. Sectors singled out to illustrate both the promise of anticipated CPS applications and obstacles that stand in the way include smart manufacturing, smart utilities, smart buildings and infrastructure, and smart transportation and mobility.

Transcending challenges and needs include cybersecurity, technology platforms with integrated architectures, interoperability standards, communication protocols, performance and quality assurance systems, seamless human-CPS interactions and education and workforce training.

The three reports are:

- Strategic R&D Opportunities for 21st Century Cyber-Physical Systems: provides a high-level perspective on key challenges and research opportunities for advancing CPS; intended to inform decisions about the technology R&D that should be pursued. Available at www.nist.gov/el/upload/12-Cyber-Physical-Systems020113_final.pdf.
- Strategic Vision and Business Drivers for 21st Century Cyber-Physical Systems: summarizes the ideas generated during an executive roundtable attended by business and technical leaders, representing a spectrum of applications for CPS, from medicine to energy to manufacturing. Available at www.nist.gov/el/upload/Exec-Roundtable-SumReport-Final-1-30-13.pdf.
- Foundations for Innovation in Cyber-Physical Systems: summarizes the results of a workshop where scientists and engineers identified and prioritized technical barriers—including measurement science and standards-related needs—that impede progress. Available at http://www.nist.gov/el/isd/cps-020613.cfm

NIST to Host Three Presidential Innovation Fellows

The National Institute of Standards and Technology (NIST) expects to host three new Presidential Innovation Fellows (PIF) from the latest round announced yesterday by the White House.* The PIF program pairs top innovators from the private sector, nonprofits and academia with top innovators in government to collaborate during six-to-12 month "tours of duty" that aim to save lives, save taxpayer money and fuel job creation. Fellows are funded by the sponsoring agencies.

This is the second round of the PIF program, which began in 2012, and expands it to nine projects, five of which are new, including those that involve NIST. Applications to be a Round 2 Fellow will be accepted through March 17, 2013.

NIST's three fellows will work on two different projects: Cyber-Physical Systems and MyData Initiatives. Cyber-Physical Systems refers to combining networking and information technology with physical systems to create a new generation of systems that integrate distributed networks of sensors, controls and processors. These new systems are on the cusp of unleashing innovation in areas such as manufacturing, transportation, utility infrastructures and buildings, including home appliances and remote sensors.**

NIST's two Cyber-Physical Systems fellows will work with industry and government partners to create critically needed standards for interoperability, cybersecurity, and real-time data analytics based on integrated system architectures.

The NIST fellow in the MyData Initiatives project will work on the Green Button Initiative, which aims to enable energy customers to download their energy usage data securely in a machine-readable format directly from their utilities. NIST's fellow will be part of a three-member "Green Button for America" team, the other two members of which will work from the Department of Energy.

*For more information on the program, or to apply, visit www.whitehouse.gov/InnovationFellows. The White House news announcement, "Throw Your Hat in the Ring for Round 2 of the Presidential Innovation Fellows Program," is available at www.whitehouse.gov/blog/2013/02/05/throw-your-hat-ring-round-2-presidential-innovation-fellows-program.

** See related story in this issue, "New Reports Define Strategic Vision, Propose R&D Priorities for Future Cyber-Physical Systems".

‘Live Burns’ in Spartanburg, S.C., Will Benefit Research and Firefighter Training

Fire researchers from the National Institute of Standards and Technology (NIST) and colleagues from fire service organizations will turn abandoned wood-frame, single-family houses near the site of an old Spartanburg, S.C., textile mill into proving and training grounds for new science-driven fire-fighting techniques this week. The objective of the study is to improve firefighter safety and effectiveness.

Experiments conducted in eight different houses will demonstrate fire-fighting methods—individually and in combinations—for strategically ventilating and isolating fires to prevent—or at least delay—flashover, the extremely perilous phenomenon that occurs when heat builds up in a burning structure’s contents and components to the point that they burst into flames simultaneously.

In conjunction with the experiments, the International Society of Fire Service Instructors (IFSI) will videotape how firefighters implement size-up, flowpath control, and exterior fire attack, also known as transitional attack. The IFSI will then develop training modules that will be available to firefighters across the country.

Other collaborators in the field experiments include the International Society of Fire Service Instructors, the South Carolina Fire Academy, the Spartanburg Fire Department, the South Carolina State Fire Marshal’s Office and the Spartanburg Public Safety Office. The project is funded with a DHS/FEMA Assistance to Firefighters Grant.

In July 2012, in another team effort, NIST fire researchers gathered data in experimental burns in 20 abandoned townhouses on New York’s Governors Island, about a kilometer from the southern tip of Manhattan.

The Spartanburg fire tests are being conducted in an area slated for a major redevelopment initiative.

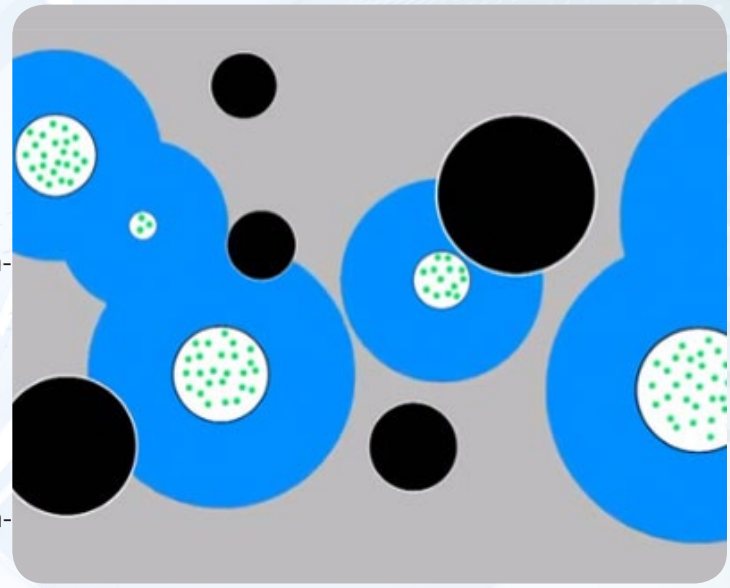
Firefighters in Spartanburg, S.C., battle a ‘test burn’ of an abandoned house in an experiment to demonstrate new techniques for combatting flashover, an extremely dangerous phenomenon in fires. Researchers from NIST, the International Society of Fire Service Instructors, and state and local fire and safety officials participated in the tests the week of Jan. 20, 2013
Credit: Madrzykowski/NIST

Report from the Field: Using Internally Cured Concrete in Indiana Bridges

A recent news story from Purdue University describes how Indiana state transportation officials are making concrete use of concrete research to extend the service life of bridge decks in the state and to lower repair and maintenance costs. The Indiana engineers are using new "internally cured" high-performance concrete, a technology championed by researchers from Purdue and the National Institute of Standards and Technology (NIST).

Water is an essential part of the chemical reaction that gives concrete its strength, explains NIST engineer Dale Bentz, and it can add to the strength of the material for a long time, if it's available. "The chemical reaction is ongoing for years and years," Bentz explains. "It essentially never stops, but it keeps going slower and slower. Usually, about 75 percent of the reaction has occurred by 28 days, but the other 25 percent might happen over many, many years, as long as there is still water available and those reactions can still take place."

Bentz worked with Purdue's Jason Weiss on the definitive review* of internal curing, a technique to extend the life and durability of concrete by distributing an extra supply of water uniformly throughout the concrete in absorbent materials that are mixed in with the cement and aggregate that make up concrete. (See the March, 2011, NIST Tech Beat story, "High-Tech Concrete Technology Has a Famous Past" at www.nist.gov/public_affairs/techbeat/tb20110315.cfm#concrete.)



One of the most important effects of internal curing is to make the concrete more resistant to early-age cracking, Bentz says. This is especially important for concrete bridge decks, where such cracks allow winter deicing salts to more rapidly infiltrate the concrete and attack steel reinforcing bars.

In addition, says Bentz, internal curing is particularly important for "greener," more environmentally friendly concrete mixtures. "For sustainability, engineers are trying to take out more cement and replace it with other materials, such as fly ash. Cement production is very energy intensive and has a significant CO2 footprint—making a ton of cement produces almost a ton of carbon dioxide. But in these high-volume fly ash mixtures, internal curing is important because while the fly ash will react with the cement, it takes a lot longer. After 28 days, maybe 30 percent or less of the fly ash has reacted, so you really need to keep the concrete saturated for an extended period of time."**

Read the Purdue University story, "Indiana using new concrete to increase bridge life span" at www.purdue.edu/newsroom/releases/2013/Q1/indiana-using-new-concrete-to-increase-bridge-life-span.html.

Another recent development of the NIST and Purdue work on internal curing is the approval, this past summer, of a new standard specification by ASTM International. ASTM C1761-12, Standard Specification for Lightweight Aggregate for Internal Curing of Concrete, provides test methods and other information for evaluating and incorporating lightweight, absorbent aggregates for internal curing of concrete.

* D.P. Bentz and W.J. Weiss. Internal Curing: A 2010 State-of-the-Art Review (NISTIR 7765). Feb. 2011. Available at: www.nist.gov/manuscript-publication-search.cfm?pub_id=907729.

** See, for example: I. de la Varga, J. Castro, D. Bentz and W.J. Weiss. Application of internal curing for mixtures containing high volumes of fly ash. Cement and Concrete Composites, 34 (9), 1001-1008, 2012.

NIST and Forest Service Create World's First Hazard Scale for Wildland Fires

Two federal agencies have teamed to create the first-ever system for linking accurate assessments of risk from wildland fires to improved building codes, standards and practices that will help communities better resist the threat. The proposed Wildland Urban Interface (WUI) Hazard Scale addresses fires that occur where developed and undeveloped areas meet, and is described in a report* released today by the U.S. Department of Commerce's National Institute of Standards and Technology (NIST) in collaboration with the U.S. Department of Agriculture's U.S. Forest Service (USFS).

"Structures in areas susceptible to other natural hazards, such as earthquakes, hurricanes and tornados, can be built to address the potential risks from these disasters because we have measurement scales that define that risk—the Richter for quakes, the Saffir-Simpson for hurricanes and the Enhanced Fujita for tornados," says NIST's Alexander Maranghides, who created the new wildfire hazard assessment tool with William Mell of the USFS. "Now, we have proposed a scale specifically for wildland fires that will allow us to link exposure to improved codes and standards, and as a result, save lives, property and dollars."

The problem of WUI** fires, particularly in the western and southern regions of the United States, has been growing more prevalent as housing developments push into wilderness areas. According to the Bureau of Land Management's National Interagency Fire Center (NIFC), the 10 years since 2002 saw an annual average of nearly 71,000 WUI fires recorded and 1.9 million hectares (4.7 million acres) burned. Through the end of October 2012, the number of WUI fires for the year is below the average at slightly more than 54,000, but the amount of damage is nearly double with 3.7 million hectares (9.1 million acres) having burned—approximately 1,000 times the total area of Rhode Island. The monetary toll from the destruction is staggering; the NIFC estimates that

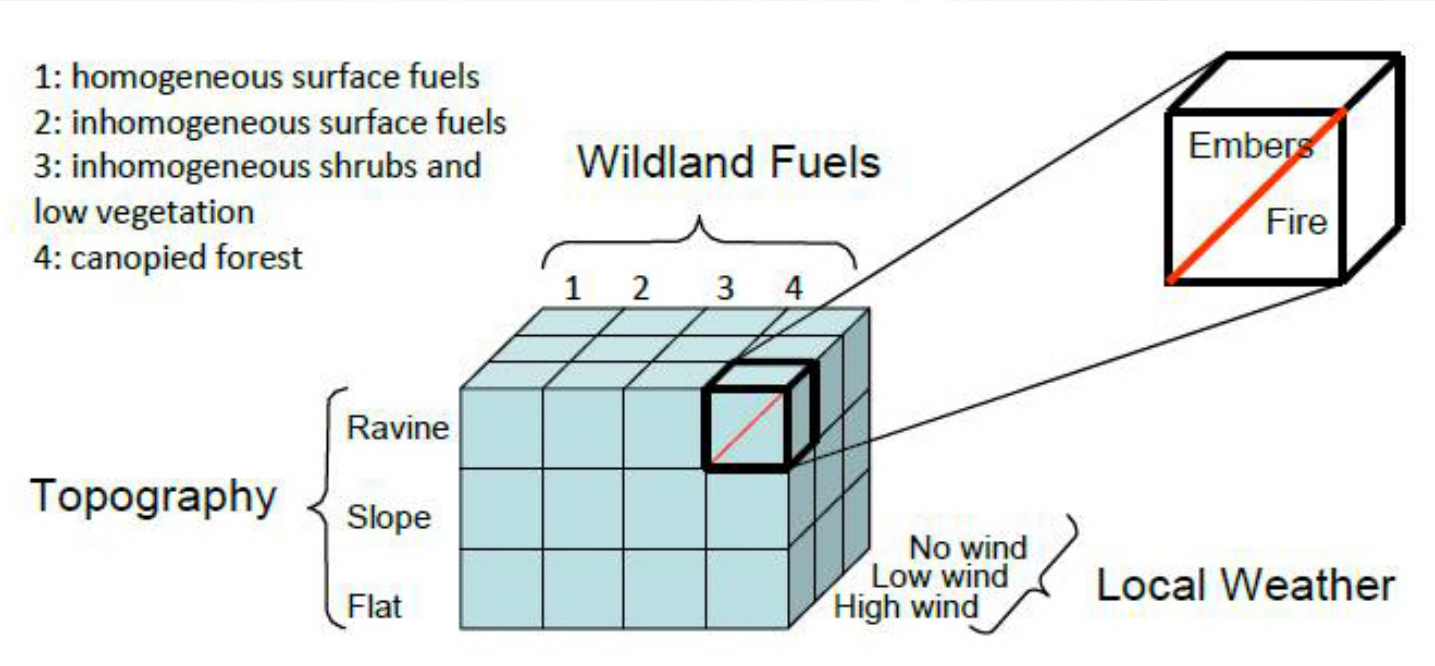


Figure 1. Matrix for Capturing Exposure from Wildland Fuels

One side of the matrix represents the four types of fuel sources considered: homogeneous surface fuels (such as prairie grasses), inhomogeneous surface fuels (such as palmetto), inhomogeneous shrubs and low vegetation (such as chaparral) and canopied forest (such as the forests of pine, cedar, juniper or aspen found in the intermountain west region between the Rockies and the Sierra Madre/Cascades). The other two sides of the matrix represent three types of topography (ravine, slope and flat) and three local weather conditions (no wind, low wind and high wind).

Credit: Alex Maranghides/NIST

federal agencies spend an average of $1.2 billion per year on WUI fire suppression alone, with state and local agencies contributing millions more.

To combat such tremendous losses, NIST and USFS have developed a proactive approach that could one day provide buildings and the communities in which they reside with increased resistance to WUI fires. The WUI Hazard Scale is designed to consistently measure the expected risks from fire and embers during a WUI fire event for individual locations within a community, taking into account the ever-changing nature of those hazards.

"Wildfires are among the few natural disasters in which risk levels can rapidly change as the event progresses and the threat doesn't weaken with distance away from a well-defined epicenter, as in a tornado," Mell says. "For example, if your home is nestled deep within a neighborhood away from the leading edge of a fire, you might not be at risk early on. However, the danger to your home dramatically increases if a neighboring house, the surrounding landscape or a nearby vehicle catches on fire."

Fire behavior in wildlands and the wildland urban interface is a function of fuel (both vegetation and structures), topography and local weather. The WUI Hazard Scale accounts for local and transient variations in these factors so that each specific location can be rated as to its susceptibility to both fire and embers. The range of ratings can then be used to create a map of the different levels of risk throughout a community and pinpoint where protective measures or "hardening" of structures are most needed.

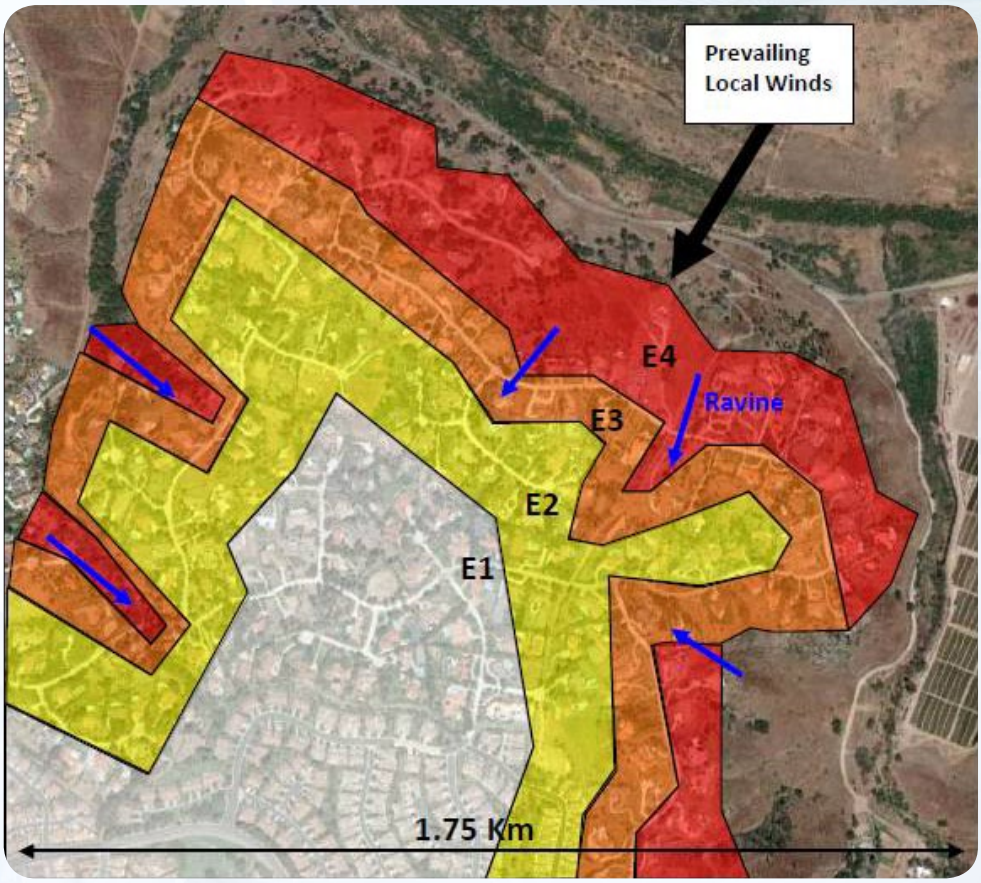


Figure 2. Wildland Ember Exposure on a Community Using the WUI Fire Hazard Scale

The ember risks shown in this illustration increase from E1, no likely exposure, to E4, highest likelihood of exposure. Credit: Alex Maranghides/NIST

Once the overall exposure risk in a particular zone is determined, the researchers say they can predict the likely response of individual structures and even components of those structures (such as whether or not a wooden deck is treated with a fire retardant) to embers and fire.

As portrayed in today's report, the WUI Hazard Scale currently considers fire and ember exposure from a single source, wildland fuels. The researchers have designed the scale to easily accommodate additional threats and plan to include exposure from three other sources associated with WUI fires—burning structures, ornamental vegetation and vehicles—at a later date, using the same methodology.

In their report, Maranghides and Mell portray the WUI Fire Hazard Scale for fire and ember exposure as a three-dimensional matrix (see Figure 1). One side of the matrix represents four types of fuel sources; a second, three types of topography; and a third, three wind conditions.

* A. Maranghides and W. Mell. NIST Technical Note 1748: Framework for Addressing the National Wildland Urban Interface Fire Problem – Determining Fire and Ember Exposure Zones using a WUI Hazard Scale (2012).

** USFS defines the wildland urban interface, or WUI, as an "area where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels."

Field data collected from and computer modeling of prescribed burns (controlled fires used in wildland management) were used to define the specifics of the fuel, topography and weather characteristics attributed to different "exposures"—four for embers and four for fire, ranging in severity from 1 (no exposure) to 4 (most severe exposure). Based on this, each block in the WUI Fire Hazard Scale matrix is assigned a measure of severity for both embers and fire. These exposure ratings are used to map a community's varying risks from embers and fire (see Figure 2).

To link the scale to a means of protecting communities, Maranghides and Mell have proposed four "building construction classes" defined for different risk zones in a mapped community. Structures in a zone designated with a low exposure risk from embers or fire would require no special construction considerations. At the other end of the spectrum, a structure built in a zone with the greatest exposure risk would require a high level of construction hardening measures such as windows and doors being covered with insulated, noncombustible coverings and landscaping that was irrigated and well maintained for low flammability.

"If homes and other buildings in the most susceptible zones can be built or retrofitted to high-risk standards, they could potentially serve as a 'frontline defensive wall' for the structures in the lower-risk zones they surround," Maranghides explains. "In effect, we may be able to mitigate the entire dynamic of a WUI fire event if the frontline structures don't ignite."

Maranghides says that now that the hazard scale proposes a framework for addressing the WUI fire problem, the next step is to collect the appropriate data to make it viable. NIST and USFS, he says, will do this through field evaluations of exposure characteristics in a wide variety of communities and surveys of areas that have recently experienced WUI fires. The two agencies also will be working with various public and private stakeholder groups toward acceptance and implementation of the proposed scale and building construction classes with the goal of improving standards, codes and practices.

NIST's work on WUI fires is part of its statutory responsibilities for enhancing disaster resilience by reducing the risks of fires, earthquakes, windstorms and coastal inundation on buildings, infrastructure and communities, including facility occupants/users and emergency responders.

The mission of USFS is to sustain the health, diversity and productivity of the nation's forests and grasslands to meet the needs of present and future generations. The agency manages 193 million acres of public land, provides assistance to state and private landowners, and maintains the largest forestry research organization in the world.

As a nonregulatory agency of the U.S. Department of Commerce, NIST promotes U.S. innovation and industrial competitiveness by advancing measurement science, standards and technology in ways that enhance economic security and improve our quality of life.

New York Taps NIST's Sunder for Post-Sandy Review of Critical Systems and Services

Shyam Sunder, director of the Engineering Laboratory at the National Institute of Standards and Technology (NIST), has agreed to serve on the New York State Ready Commission, formed by Governor Andrew Cuomo to recommend ways to ensure critical systems and services are prepared for future natural disasters and other emergencies.

The expert commission is one of three that Cuomo launched in the aftermath of recent major storms, including Hurricanes Sandy and Irene, that devastated parts of the state and revealed weaknesses in New York's transportation, energy, communications and health infrastructures.

The Ready Commission will review critical systems and services and recommend measures to prepare for future natural disasters and other emergencies. It also will advise the governor on ways to ensure:

- new, modified and existing construction is resilient;
- adequate equipment, fuel, food, water and other emergency supplies are available;
- first responders and other critical personnel can communicate efficiently and have access to adequate resources;
- reliable, real-time information is available for decision makers; and
- lines of authority are clear and officials have the authority to react rapidly to emergency situations.

Cuomo issued an Executive Order on Nov. 15, 2012, to form the Ready Commission and the two others—one focusing on responses to future weather-related disasters and the other on ways to improve the resilience and strength of the state's infrastructure in the face of natural disasters and other emergencies.

Preliminary recommendations by all three commissions are due on Jan. 3, 2013.

As director of the NIST Engineering Laboratory, Sunder manages an annual budget of $90 million, 260 employees, and about 150 guest researchers from U.S industry and universities as well as foreign laboratories. He oversees NIST's statutory responsibilities for enhancing disaster resilience by reducing the risks of fires, earthquakes, windstorms and coastal inundation on buildings, infrastructure and communities, including facility occupants/users and emergency responders. He also oversees the multiagency U.S. National Earthquake Hazards Reduction Program. Sunder led the federal building and fire safety investigation of the World Trade Center Disaster in the aftermath of the terrorist attacks of September 11, 2001.

Dr. S. Shyam Sunder

Credit: Berkemeyer/NIST

To read the press release announcing the launch of the commissions, go to: www.governor.ny.gov/press/11152012-Emergency-Preparedness.

NIST Workshop Seeks Manufacturers' Ideas on Using Multipurpose Robots

The National Institute of Standards and Technology (NIST) wants to help turn manufacturing robots into dexterous, nimble-fingered machines—affordable mechanical helpers that can easily handle different types of objects and flexibly assist human workers at even small U.S. factories.

At a January 24, 2013, workshop in Chicago, Ill., NIST researchers and their partners from industry will be asking manufacturers to identify where in assembly and other production-related operations dexterous robots would provide the biggest boost to their capabilities and process efficiency. Sponsored by the Robotics Industry Association, the NIST Workshop on Dexterous Manipulation for Manufacturing Applications will be held in conjunction with Automate 2013, a biennial conference and trade show focusing on process automation.

Three sessions will feature presentations by industry leaders on dexterous grasping, robot arm technology, and flexible manufacturing. Each session will conclude with an open-format panel discussion on needs and opportunities for dexterous manipulation in next-generation manufacturing systems, especially for low-volume production runs.

Today's manufacturing robots are largely limited to performing repetitive, and sometimes, dangerous, tasks such as spot welding or picking and placing heavy parts. Typically, they require expensive, customized tooling, and for safety reasons, are situated in cordoned-off workspaces.

When the dimensions or shape of an assembly part are altered, tool changers are used to swap out a robot's grippers or other so-called end-effector devices that are customized for specialized tasks. This high degree of specialization greatly increases product changeover time and cost.

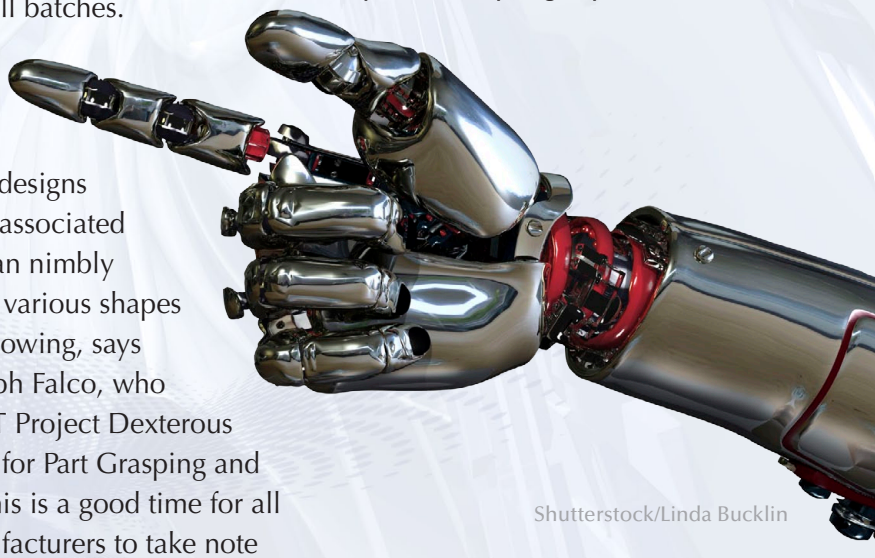
A goal of researchers at universities and companies around the world is to develop robot grippers with flexibility and sensitivity approaching that of the human hand. If effective, reliable, and affordable, such dexterous end-effectors would transform how and where robots are used in manufacturing, opening the way to new ways of making things in both large and small batches.

The number of promising, but still experimental designs of robots and associated tooling that can nimbly wield parts of various shapes and sizes is growing, says engineer Joseph Falco, who leads the NIST Project Dexterous Manipulation for Part Grasping and Assembly. "This is a good time for all types of manufacturers to take note of these developments and to think about how they might make the best use of these emerging technologies and capabilities in their operations," Falco explains.

A goal of the NIST project is to develop a prototype measurement system to gauge the performance of still-experimental universal robotic grasping tools with novel geometries and articulation, including hand-like designs hands. Information gathered at the workshop will help guide work toward this goal and others that Falco and his team are pursuing. Workshop input will be summarized in a future publication.

For workshop information, go to: www.nist.gov/el/isd/dexmanworkshop.cfm. The Automate 2013 website is www.automate2013.com.

For information on the NIST Project Dexterous Manipulation for Automation Systems, go to: www.nist.gov/el/isd/ps/dexmanpartgraspassem.cfm.



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States Realize Big Benefits by Keeping Current with Energy Standards for Buildings

States that have not adopted the latest energy-efficiency standard for commercial buildings are foregoing an average reduction of almost 10 percent in energy consumed by new structures over 10 years, which would trim their energy costs and carbon emissions by over 12 percent, according to a study* by an economist at the National Institute of Standards and Technology (NIST).

As important, the sizeable reductions in energy use and carbon emissions are cost-effective, says NIST's Joshua Kneifel, who analyzed energy usage and other variables for more than 12,500 buildings across 228 U.S. cities. Overall, more stringent efficiency requirements do not increase total construction and future operation costs for new commercial buildings. In fact, the average life-cycle cost over 10 years decreases by an average of nearly 1 percent, Kneifel found.

The analysis reveals that there are energy-efficiency gains to be had nationwide. Even in the 31 states that have adopted the more recent update of the energy standard for commercial buildings,** only slightly more rigorous requirements—such as increasing the thermal efficiency of insulation and reducing lighting densities—can deliver substantial benefits.

Kneifel estimates that if all 50 states adopted a "low energy case" building design, newly constructed buildings would consume about 18 percent less energy in the average state. Over the 10-year study period, this average would translate into energy cost savings of more than 22 percent and a 20 percent reduction in energy-related carbon emissions. Building life-cycle costs over those 10 years would dip by about 1 percent.

The largest energy, cost and environmental benefits, of course, would go to the 11 states that today have no commercial building energy code and the three using the oldest version of the efficiency standard, which is updated about every three years by ASHRAE, a building technology standards organization. If these states adopted the study's low energy design, all 14 would realize at least a 25 percent decrease in their total energy use and reductions of about 30 percent in energy costs and carbon emissions.

Kneifel's analysis is based on computer simulations of how 11 different types of buildings—from high schools, restaurants and retail stores to office buildings, hotels and apartments—use energy. These building types represent 46 percent of the nation's commercial building stock floor space. The 228 cities included in the study were distributed across the nation and are representative of all climates across the country. The study also considered variation in energy sources and fuel mixes for electric power—for example, the percentages of power generated by coal or natural gas.

The NIST economist also conducted detailed analyses of seven states that represent the full range of state energy-efficiency codes, climate types, and new commercial building floor space added between 2003 and 2007. In addition to providing a wealth of comparative information on energy use and efficiency for the seven states, the analyses demonstrate the usefulness of a new NIST database and software tools that will debut in late 2013. Called BIRDS (for Building Industry Reporting and Design for Sustainability), the free, Web-based tool kit will further research, design, and planning efforts focused on building energy use and technologies to improve energy efficiency.

BIRDS complements NIST's Building for Environmental and Economic Sustainability tool (commonly known as BEES). Widely used in industry and government, BEES includes actual environmental and economic performance data for 230 building products and science-based techniques for selecting cost-effective, environmentally preferable building products.

* J. Kneifel, Benefits and Costs of Energy Standard Adoption in New Commercial Buildings, NIST Special Publication 1147, February, 2013. http://dx.doi.org/10.6028/NIST.SP.1147

** ASHRAE Energy Standard for Buildings Except Low-Rise Residential Buildings (ASHRAE-90.1-). For more information: https://www.ashrae.org/resources--publications/bookstore/standard-90-1#2007.

New Guide Will Allow Electric Utilities to Develop Green Button Web Tools

A new guide* for Web developers recently released by the National Institute of Standards and Technology (NIST) will make it easier for electric utilities and vendors to give customers convenient, electronic access to their energy usage data with tools and applications developed as part of the new "Green Button" initiative.

Green Button aims to provide electricity and gas consumers with their own energy usage information in an understandable and computer-friendly standardized electronic format via a "Green Button" on a utility's web site. Consumers armed with this information can then use an array of new Web applications to make more informed energy decisions and to verify that their energy-efficiency investments are performing as promised. To help utilities and vendors create Web services and applications that communicate and handle Green Button data appropriately, NIST created a special Software Development Kit, which the new guide will help developers use effectively.

"The User Guide is a playbook for implementation of the Green Button Software Development Kit," says David Wollman, the NIST lead for Green Button and program manager for smart grid standards and research in NIST's Smart Grid and Cyber-Physical Systems Program Office. "All the different technical innovators—Web designers, entrepreneurs, utility experts—will find the help they need inside."

Included in the new guide is information on:

- The composition of Green Button data and how it fits together
- How to make Green Button data accessible to users via XML style sheets, which render the data comprehensible to the consumer; and
- Sample source code showing what data to begin with, as well as examples of finished data sets

The User Guide, which is freely available via the website, contains all the lessons learned since the announcement of the Green Button Initiative in September 2011 and the release of the Software Development Kit the following month. It provides a good overview for those utilities not yet using Green Button, Wollman says.

For more information on Green Button, please visit www.nist.gov/smartgrid/greenbutton.cfm

*The User Guide for the NIST Green Button Software Development Kit is available at https://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/GreenButtonSDK and includes a link to the NIST Green Button Software Development Kit source repository. It was produced with the technical support of Marty Burns of Hypertek, Inc., a contractor to NIST.

New NIST Report Provides Comprehensive Overview of U.S. Manufacturing

A new report from the National Institute of Standards and Technology (NIST) provides a comprehensive, top-level view of The Current State and Recent Trends of the U.S. Manufacturing Industry.*

Drawing on a variety of domestic and international data sources, NIST economist Douglas S. Thomas assesses the roles that $1.8 trillion sector plays in the national economy and compares U.S. manufacturing performance against that of other countries, using an assortment of measures.

"This report provides a uniquely wide range of useful indicators for analysis of manufacturing growth policies," said NIST Chief Economist Gregory Tassey. "These indicators cover all phases of the technology life cycle, filling a critical data gap essential for assessing existing policies and projecting needed adjustments to those policies."

Thomas's study also points out how shortcomings in available data sets can limit their usefulness and complicate efforts to identify and understand changes in the manufacturing sector.

The current state and future of U.S. manufacturing are much discussed these days. Popular assessments, often anecdotal, may convey conflicting impressions—that the sector's "glass" is either half full or half empty. And commentators may marshal statistics to support their particular view.

For example, Thomas points out that in 2008 the United States was the world's largest manufacturer, accounting for 18 percent of global production. The U.S. share has declined by more than a third since 1985. As developing countries industrialize, their levels of income and production increase and so does their piece of the world's manufacturing pie. However, Thomas explains that as these emerging economies grow, they purchase more goods and services, enlarging the pie.

In fact, the value of U.S. manufacturing output grew at a compounded annual rate of 1.8 percent between 1985 and 2008, somewhat slower than the economy as a whole. Internationally, according to United Nations (UN) statistics, the sector's growth rate placed it 151st among 180 nations. As might be expected, most of the countries with faster manufacturing growth rates were developing economies, but not all. Canada, Japan, Germany, and the United Kingdom also grew at faster average annual rates over the 23-year span.

Other key findings in the report include:

- U.S. manufacturing per capita has lagged slightly behind some industrialized nations, such as Germany and Japan. At least 20 other nations had a higher manufacturing value added per capita than the U.S. in 2008, according to UN data.
- Manufacturing accounts for 27.9% of U.S. national output (which includes the sales and purchases of final and intermediate goods and services), according to data compiled by the Organization and Economic Cooperation and Development (OECD). This share is less than that for Canada, China, Germany, India, Japan, and Mexico, as well as some other nations.
- Among industrialized countries, the average U.S. manufacturing wage ranks in the top 90 percent, according to the OECD.

To download a PDF copy of the new 138-page report click on this URL: http://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.1142.pdf

*D.S. Thomas, The Current State and Recent Trends of the U.S. Manufacturing Industry. NIST Special Publication 1142, Dec. 2012.

Three Experts Named to Earthquake Advisory Board

Three earthquake authorities from academia and the private sector have been appointed by Patrick Gallagher, Under Secretary of Commerce for Standards and Technology and Director of the National Institute of Standards and Technology (NIST), to serve on the Advisory Committee on Earthquake Hazards Reduction (ACEHR) of the National Earthquake Hazards Reduction Program (NEHRP).

Established by the Earthquake Hazards Reduction Act of 1977, NEHRP is the federal government's program to reduce the risks to life and property from earthquakes. NEHRP consists of four federal agencies: the Federal Emergency Management Agency (FEMA), the National Science Foundation (NSF), the United States Geological Survey (USGS) and NIST, which serves as lead agency.

The new ACEHR members, whose terms extend to July 31, 2015, are: Craig Davis, geotechnical engineering manager, Los Angeles Department of Water and Power, Los Angeles, Calif.; Robert Herrmann, Paul C. Reinert Chair of Natural Sciences, Saint Louis University, St. Louis, Mo.; and Mary Lou Zoback, seismologist and consulting professor, Stanford University, Stanford, Calif. They join a group of nine previously appointed academic, industry and government experts on the ACEHR.

The committee's responsibilities include assessing:

- trends and developments in the science and engineering of earthquake hazards reduction;
- the effectiveness of NEHRP in performing its statutory activities (fostering improved design and construction methods and practices; land use controls and redevelopment; prediction techniques and early-warning systems; coordinated emergency preparedness plans; and public education and involvement programs);
- any need to revise NEHRP; and
- the management, coordination, implementation, and activities of NEHRP.

More information on NEHRP and the ACEHR can be found at http://www.nehrp.gov.

Staff Awards

Emil Simiu

NIST Fellow

Structural Engineer magazine's 2012 Power List

For "For advancing the profession and developing solutions to some of the world's toughest problems"

Simon Frechette & Paul Huang

Systems Integration Division

Awarded the 2012 DoD Defense Manufacturing Technology Achievement Award

For advancement of 3D technical data package and data certification standards that will reduce defense system lifecycle support costs

Terri McAllister

Selected to become an SEI Fellow by The Structural Engineering Institute (SEI) of the American Society of Civil Engineers (ASCE)

For her accomplishments in the field of structural engineering

Paul Stutzman

Receivied the 2013 ASTM International Award of Merit

For his knowledge and commitment to excellence in standards development and for having a major impact in his field and have made ASTM International a technical leader in today's global business world

Recent Publications

- Multizone Airflow Models for Calculating Infiltration Rates in Commercial Reference Buildings
- Characterization of Airborne Nanoparticle Releases from Consumer Products
- Measurement Science Needs for the Expanded Use of Green Concrete: Workshop Summary Report
- Standard Adoption in New Commercial Buildings
- Smoke Alarm Performance in Kitchen Fires and Nuisance Alarm Scenarios
- Reference Material to Improve Reliability of Building Product VOC Emissions Testing
- Development of a Reference Material for Building Product Emissions Testing
- Indoor ultrafine particles of outdoor origin: importance of building operating conditions
- Diffusion-controlled reference material for VOC emissions testing: The effect of temperature and humidity
- Standard Formaldehyde Source for Chamber Testing of Material Emissions: Modeling and Preliminary Tests
- Multizone Modeling of Strategies to Reduce the Spread of Airborne Infectious Agents in Healthcare Facilities
- Performance Improvement of a Roof Top Air-Conditioning Unit by Refrigerant Circuitry Optimization
- Performance Metrics of Speed and Separation Monitoring in Shared Workspaces
- Flow Control in Time-Varying, Random Supply Chains
- Survey Report for Ambulance Patient Compartment Design
- Framework for Addressing the National Wildland Urban Interface Fire Problem--Determining Fire and Ember Exposure Zones Using a WUI Hazard Scale
- Identifying improved standardized tests for measuring cement particle size and surface area
- Building air leakage databases in energy conservation policies: analysis of selected initiatives in 4 European countries and the USA
- Quantifying Residual Stress Development and Reserve Strength in Restrained Internally Cured Concrete
- Meteorological extremes
- The Current State and Recent Trends of the U.S. Manufacturing Industry
- Characterization of the US Construction Labor Supply
- STEP File Analyzer User's Guide
- Exposing Wood Decking Assemblies to Continuous Wind-Driven Firebrand Showers
- Standard Operating Procedures for Smolder Ignition Testing of Upholstery Fabrics

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