BFRL News
Building and Fire Research Laboratory
National Institute of Standards and Technology • U.S. Department of Commerce

Did you know?

February 2009

In the United States, construction and building is a $1.2 trillion per year industry, represents 5 percent of the gross domestic product, and employs nearly 12 million workers.

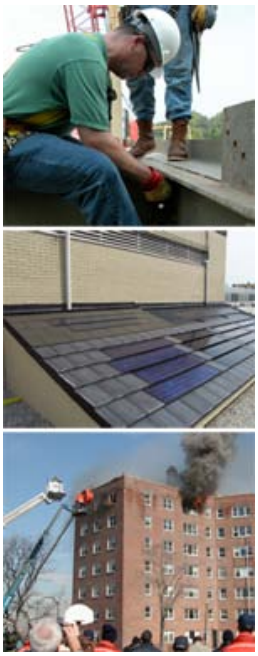


Photo Credit: NIST

- The construction industry directly affects as much as 12% of the U.S. economy when manufacturing of construction materials and components, building contents and furnishings, and renovation and maintenance are included.
- The vast majority of construction firms are small (including about 1.8 million self-employed workers), and do not have the resources to conduct the in-depth research needed to improve building practices.
- Buildings represent the single largest end-user of energy (40%) and electricity (72%) and contributor of carbon-dioxide emissions (39%) when compared with the transportation and industrial sectors.
- The U.S. costs due to natural and technological disasters are $55 billion per year and growing, with future catastrophic events possibly causing mega-losses in excess of $100 billion.
- Fire is a major problem in the United States, which has one of the worst fire fatality rates of the world's industrialized nations. Even with improvements in fire protection and safety, in 2006, 3,245 lives were lost in fires, 16,400 more were seriously injured, direct property loss was almost $12 billion, and fire cost the U.S. economy in excess of $250 billion per year.

BFRL's research addresses the key *drivers* for change in construction: sustainability, energy independence, and environmental security; demand for better quality, faster, and less costly construction; competition due to globalization and offshoring; renewal of the nation's aging physical infrastructure; and homeland security and disaster resilience.

BFRL's research also addresses the key *barriers* to change in construction: declining productivity and industry fragmentation; minimum first-cost mindset which precludes lower-cost investment options based on life-cycle performance; and prescriptive standards and codes which stifle innovation and competitiveness; and very low investment in research and development.

Standards and Codes

The International Code Council (ICC) recently approved 23 major and far-reaching building and fire code changes based on recommendations from NIST's investigation of the collapses of New York City's World Trade Center (WTC) towers on Sept. 11, 2001. The changes, adopted at the ICC hearings held Sept. 15-21, 2008, in Minneapolis, Minn., will be incorporated into the 2009 edition of the ICC's *I-Codes* (specifically the International Building Code, or IBC, and the International Fire Code, or IFC.)

The new codes address areas such as increasing structural resistance to building collapse from fire and other incidents; requiring a third exit stairway for tall buildings; increasing the width of all stairways by 50 percent in new high-rises; strengthening criteria for the bonding, proper installation and inspection of sprayed fire-resistive materials (commonly known as "fireproofing"); improving the reliability of active fire protection systems (such as automatic sprinklers); requiring a new class of robust elevators for access by emergency responders in lieu of an additional stairway; making exit path markings more prevalent and more visible; and ensuring effective coverage throughout a building for emergency responder radio communications.

Summaries of the approved changes (and unapproved proposals) along with a chart tracking the progress toward implementing all of the NIST WTC recommendations, may be found at http://wtc.nist.gov/.

As always, I invite you to visit our web site (http://www.bfrl.nist.gov/) and encourage you to contact us (bfrl@nist.gov).

Sincerely,
Dr. S. Shyam Sunder
Director, Building and Fire Research Laboratory

Development of the 2009-2013 NEHRP Strategic Plan

Laboratory testing of an older concrete column design. Photo copyright 2002 by Pacific Earthquake Engineering Research Center.

Earthquakes pose one of the greatest natural hazards in the United States, with potential for significant casualties and damage to buildings and infrastructure. According to a 2006 National Research Council (NRC) report, 42 States have some degree of earthquake risk and 18 of those States have areas of high or very high seismicity. Over 75 million Americans live in urban areas with moderate to high earthquake risk. The NRC report notes that the estimated value of structures in all States prone to earthquake damage is approximately $8.6 trillion (2003 dollars).

The mission of the National Earthquake Hazards Reduction Program (NEHRP) is to develop, disseminate, and promote knowledge, tools, and practices for earthquake risk reduction-through coordinated, multidisciplinary, interagency partnerships among the NEHRP agencies and their stakeholders-that improve the Nation's earthquake resilience in public safety, economic strength, and national security. The new NEHRP Strategic Plan for fiscal years 2009-2013 outlines a cooperative program of earthquake monitoring, research, implementation, education, and outreach activities performed by the NEHRP agencies. The plan was developed jointly among the four NEHRP agencies, the Federal Emergency Management Agency (FEMA), the National Institute of Standards & Technology (NIST), the National Science Foundation (NSF), and the United States Geological Survey (USGS), and the earthquake stakeholder community. Two workshops, involving over 60 stakeholders, were held in 1999 and 2000 to help identify priority implementation activities (Appendices A and B). The input offered during the workshops has had a significant impact on the overall direction of future earthquake hazard mitigation efforts as identified in the Plan. The stakeholder involvement has assured that Federal efforts are coordinated with state and local governments as well as the private sector.

The plan adds nine new cross-cutting Strategic Priorities that directly support the goals and augment other ongoing agency activities needed to satisfy them. The Strategic Priorities were developed through a number of key activities in 2006 that highlighted gaps in the Program activities that were outlined in the previous Plan.

For more information on the new NEHRP Strategic Plan, see the website: http://www.nehrp.gov/ or contact Jack Hayes at jack.hayes@nist.gov.

Recognitions

The **Gold Medal Award** is the highest honor award conferred upon an employee by the Department of Commerce. It is bestowed for "distinguished performance characterized by extraordinary, notable, or prestigious contributions that impact the mission of the Department of Commerce and/or one operating unit and that reflect favorably on the Department." The award was initiated in 1949. BFRL staff members that received the award for 2008 are:

Stephen I. Kerber and Daniel Madrzykowski -- Mr. Kerber and Mr. Madrzykowski are recognized for advancing the science and understanding of positive pressure ventilation (PPV) and wind-driven fires and transferring this knowledge to the fire service, arson investigators, and codes officials. This research combined both experimental and modeling components to understand and document how wind impacts fires in structures and how positive pressure ventilation can improve the safety and effectiveness of fire fighters. The research has led to implementation of better fire fighting tactics and will lead to decreased injuries for fire fighters and building occupants.

Steve Kerber and Dan Madrzykowski. Photo Credit: NIST

The **Silver Medal Award** is the second highest honor awarded by the Department of Commerce. It is bestowed for exceptional performance characterized by noteworthy or superlative contributions that have a direct and lasting impact within the Department. The award was initiated in 1949. BFRL staff members that

Carbon Nanofibers Cut Flammability of Upholstered Furniture

Video of BFRL's tests involving foam flammability and nanoparticles is available online on the Foam Flammability Consortia webpage.

Carbon, the active ingredient in charcoal, is normally not considered a fire retardant, but researchers at the National Institute of Standards and Technology (NIST) have determined that adding a small amount of carbon nanofibers to the polyurethane foams used in some upholstered furniture can reduce flammability by about 35 percent when compared to foam infused with conventional fire retardants.

Ten years ago, NIST scientists found that nanoclays could be used as an effective fire retardant additive, but researchers have been seeking alternatives because nanoclay flame retardants do not prevent the melting and dripping of polyurethane foam when exposed to a fire. This molten foam actually accelerates the burning rate by as much as 300 percent. "It also creates so much smoke that it is a life-safety hazard," said Jeff Gilman, leader of the Materials Flammability Group in the Building and Fire Research Laboratory.

BFRL researchers added carbon nanofibers to the foam because they knew that adding nanoparticles to a polymer normally increases the viscosity, so it doesn't flow as easily. "The carbon nanofibers help prevent the foam from dripping in a pool under the furniture and increasing the fire intensity," Gilman said. Studies of the foam after the experiments showed that carbon nanofibers seemed to create a thermally stable, entangled network that kept the foam from dripping.

NIST fire researchers have traditionally used upholstered furniture to study its flammability, but in this study, they developed a small-scale technique for evaluating the effect of dripping and pooling on foam flammability. About the size of a slice of toast, the foam samples were treated with one of six combinations of carbon nanofibers or conventional clay flame retardants. The foam "toast" was suspended vertically over a pan, ignited, and the amount of drip was measured. The foam with carbon nanofibers did not drip. "These small-scale experiments correlate well with the fire behavior of larger foam samples and are easier and less expensive to conduct," said Gilman. "The small-scale tests will allow us to cost-effectively perform more experiments and help us find an optimal fire retardant faster." "Carbon nanofibers are still more expensive than conventional flame retardant materials, but because the price is decreasing and so little needs to be used, they could soon be an affordable and effective option," Gilman explained.

NIST fire scientists will continue to study the mechanisms that reduce flammability and dripping and work with chemical companies, nano-additive suppliers, flame retardant suppliers and foam manufacturers to test new blends of foam and carbon nanofibers to improve flame retardant material. Additionally, new work is planned to develop sustainable, environmentally friendly fire retardants using cellulosic nanofibers and testing other innovative fire retardant approaches.

For more information about this research, see the Foam Flammability Consortia webpage: http://www.bfrl.nist.gov/866/foam/ or contact Jeff Gilman at jeffrey.gilman@nist.gov.

received the award for 2008 are:

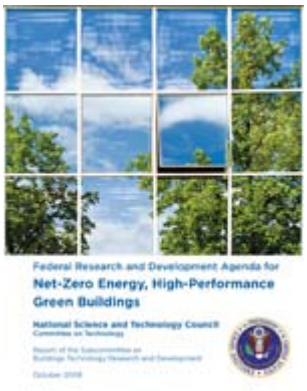
Andrew K. Persily -- Dr. Persily is recognized for contributions to the increased protection of building occupants against airborne chemical and biological releases through the development and application of measurement science and predictive tools related to building airflow and contaminant transport. His technical accomplishments have lead to new technologies and practices. Both the public and private sectors have benefited from this effort through safer and more secure buildings including iconic structures such as the U.S. Capitol and the Pentagon.

The **Bronze Medal Award**, the highest honorary recognition given by the NIST, was initiated in 1966 and is given for significant performance characterized by outstanding or significant contributions that have increased the efficiency and effectiveness of NIST. BFRL staff members that received the award for 2008 are:

William D. Davis, Michelle K. Donnelly, James R. Lawson and Michael J. Selepak -- The team is recognized for their careful and original measurements of the performance of electronic safety equipment used by emergency responders. They developed four Thermal Exposure Classes for fire fighter exposure conditions and characterized the performance of gas monitors and personal alert safety system (PASS) devices that are used by over 1.25 million fire fighters across the country.

Francine K. Amon, Nelson P. Bryner, and Andrew J. Lock -- The team is recognized for the comprehensive development of performance measurements for thermal imaging technology utilized by fire fighters and first responders. The team provided the scientific basis necessary to develop test methods that assess the performance of thermal imaging technology, allowing for better development and evaluation, and allowing fire

Federal R&D Agenda for Net-Zero Energy, High-Performance Green Buildings



Report: "Federal R&D Agenda for Net-Zero Energy, High-Performance Green Buildings"

Commercial and residential buildings consume about one-third of the world's energy. In particular, U.S. buildings account for more than 40 percent of total U.S. energy consumption, including 72 percent of electricity generation. If current trends continue, by 2025, buildings worldwide will be the largest consumer of global energy, consuming as much energy as the transportation and industry sectors combined. More effective stewardship of our resources contributes to the security, environmental sustainability, and economic well-being of the nation. Buildings present one of the best opportunities to economically reduce energy consumption and limit greenhouse gas emissions (GHGs.) Improving how buildings are designed, built, operated, renovated, and recycled could significantly alter how buildings use energy and other basic resources.

Under the auspices of the Office of Science and Technology Policy (OSTP) in the Executive Office of the President, the National Science and Technology Council's (NSTC) Buildings Technology Research and Development Subcommittee released a report describing R&D activities that could decrease use of natural resources and improve indoor environments while reducing greenhouse gas emissions and other harmful pollutants from the building sector. It draws on the recommendations of 16 executive branch agencies along with the Architect of the Capitol and the Smithsonian Institution. The National Institute of Standards and Technology (NIST) played a key role in developing the report's goals for measurement science methods, energy efficiency technologies, indoor environment quality and knowledge transfer.

This report sets out a broad agenda for research and development on technologies to decrease use of natural resources and improve indoor environments while reducing greenhouse gas emissions and other harmful pollutants from the building sector. This Federal R&D agenda contains six major building technology goals that define the major transformational advances needed for energy, water, and material use for net-zero energy, high-performance green buildings. Inspired by the building research and owner communities, the goals address R&D needs as well as implementation barriers associated with technologies that could significantly improve building performance and occupant health and productivity.

For more information, read the report here: http://www.bfrl.nist.gov/buildingtechnology/documents/%20FederalRDAgendaforNetZeroEnergyHighPerformanceGreenBuildings.pdf or contact Paul Domich at paul.domich@nist.gov.

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fighters to use improved technology to reduce fatalities and injuries to both civilians and fire fighters.

Focus on Recruiting

The strength of any organization is in its human capital resources. BFRL's ability to accomplish its unique mission ultimately depends on its ability to attract and retain talented technical staff.

BFRL aspires to become the "employer of choice" in our arena by providing an environment where our scientists and engineers can work on challenging national problems, with top notch peers and mentors, outstanding facilities, and a comprehensive benefits package. We focus on the candidate, leverage partnerships and alliances, and tailor recruitment opportunities as appropriate.

BFRL is actively recruiting at all levels in many key areas (e.g., Simulation & Analysis of Building Mechanical Equipment and Controls, Photovoltaic Module/System Measurement Science, Information Systems Integration, Characterization of Indoor Contaminant Exposure). For more details, please visit the **BFRL Career Web Site**.

BFRL's programs are focused on **five strategic measurement science goals**:

- Net-Zero Energy, High-Performance Buildings
- Breakthrough Improvements in Construction Productivity
- Sustainable Infrastructure Materials
- Innovative Fire Protection
- Disaster-Resilient Structures and Communities

In addition, BFRL carries out major statutory responsibilities assigned to it by the Fire Prevention and Control Act (1974), the National Earthquake Hazards Reduction Program Reauthorization Act (1977, amended 2004), the National Windstorm Impact Reduction Act (2004), and the National Construction Safety Team Act (2002).