An Authoritative Source of Innovative Solutions for the Built Environment
High-Performance Buildings – What will it take?

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Mission

Authorized by federal statute, the mission of the National Institute of Building Sciences is to serve the nation and the public interest by supporting advances in building sciences and technology to improve the built environment.
Public Law 93-383, Sect. 809

Congress directed the Institute to “exercise its functions and responsibilities in four general areas……….”

- **Develop and maintain** performance criteria for maintenance of life, safety, health, and public welfare for the built environment
- **Evaluate and prequalify** building technology and products
- **Conduct** related and needed investigations
- **Assemble, store, and disseminate** technical data and related information
The Institute at Work

Industry Advocacy & Outreach
- Consultative Council
- Council on Finance, Insurance and Real Estate (CFIRE)
- National Council of Governments on Building Codes and Standards (NCGBCS)

Facility Performance & Sustainability
- Building Enclosure Technology and Environment Council (BETEC)
- High Performance Building Council (HPBC)
- National Mechanical Insulation Committee
- Facility Maintenance and Operation Committee (FMOC)

Information Resources & Technology
- Whole Building Design Guide
- National Clearinghouse for Educational Facilities
- buildingSMART alliance
- National BIM Standard-U.S.

Security & Disaster Preparedness
- Building Seismic Safety Council (BSSC)
- Multihazard Mitigation Council (MMC)
- Multihazard Risk Assessment/HAZUS
The Consultative Council assembles high-level building community representatives to make recommendations on behalf of the building community directly to the executive and legislative branches of government to improve our nation’s buildings and infrastructure.
Consultative Council Members

- ASTM International (www.astm.org)
- American Institute of Architects (http://www.aia.org/)
- American Society of Civil Engineers (http://www.asce.org/)
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (www.ashrae.org)
- Associated General Contractors (http://www.agc.org/)
- Building Owners and Managers Association (http://www.boma.org/)
- Construction Specifications Institute (http://www.csinet.org/)
- ESCO Institute (www.escoinst.com)
- Estime Enterprises, Inc. (www.estimeinc.com)
- Extruded Polystyrene Foam Association (www.xpsa.com)
- Glass Association of North America (www.glasswebsite.com)
- Green Mechanical Council (www.greenmech.org)
- Grundfos Pumps Company (www.grundfos.com)
- HOK (www.hok.com)
- Illuminating Engineering Society (www.ies.org)
- International Association of Lighting Designers (www.IALD.org)
- International Association of Plumbing and Mechanical Officials (www.iapmo.org/)
- International Code Council (www.iccsafe.org)
- Laborers' International Union of North America (www.liuna.org)
- National Environmental Balancing Bureau (www.nebb.org)
- National Insulation Association (www.insulation.org)
- National Opinion Research Center at the University of Chicago (www.norc.org)
- United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry (http://www.ua.org/)
Facility Performance & Sustainability
Security & Disaster Preparedness
What is Building Science?

Building Science is the analysis and evaluation of issues critical to the development of criteria, standards and practices that yield buildings and structures that respond to the environmental, societal, business and sustainable needs of our nation.

Henry L. Green, Hon. AIA, 2011
Why Buildings Matter

• In the U.S.:
  – Represents more than 50% of the nation’s wealth
  – New construction and renovation activity amounts to over $800 billion annually
  – Responsible for 13% of the GDP
  – Employs over ten million people (5% total U.S. employment)
  – Citizens spend 90% of their time indoors
  – Today’s buildings will still exist for years to come
  – Everyone has a point of reference
Why Buildings Really Matter
They are a Key Aspect of the Economy!

- Secure
- Accessible
- Productive
- Aesthetics
- Sustainable
- Resilient
- Cost Effective
- Historic Preservation
- Utilities
- Finance
- Workforce
- Transportation
- Materials
- Manufacturing
High-Performance buildings means a building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy [and water] conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.

-Energy Independence and Security Act of 2007 §401 (PL 110-140)
In 2005, water use in the buildings sector was estimated at 39.6 billion gallons per day, which is nearly 10% of total water use in the United States.

From 1985 to 2005, water use in the residential sector closely tracked population growth, while water use in the commercial sector grew almost twice as fast.

In 2005, between 27 billion and 39 billion kWh were consumed to pump, treat, distribute, and clean the water used in the buildings sector, accounting for 0.7 to 1% of net electricity generation.
U.S. Primary Energy Use

- Industry: 32%
- Buildings: 40%
- Transportation: 28%

22% Residential
- Refrigeration 8%
- Cooling 12%
- Lights 11%
- Water Heat 12%
- Heating 31%
- Other 4%

18% Commercial
- Refrigeration 4%
- Office Equipment 6%
- Ventilation 6%
- Water Heat 7%
- Cooling 13%
- Heating 14%
- Lights 26%
- Other 13%

Cooking 5%
Electronics 7%
Wet Clean 5%
Is the Whole Just the Sum of Its Parts?
Attributes for High Performance

- Sustainable
- Cost Effective
- Accessible
- Productive
- Historic
- Aesthetics
- Functional
- Safe/Secure
It’s High Performance Not High Desires!
Design

Construction

Operations
Specifiers’ Properties information exchange (SPie)

Equipment Layout information exchange (ELie)

Performance Standards

Equipment Lists

Warranties and Spares

Approved Submittals

Construction-Operations Building information exchange (COBie)

Keys to Facility Management Handover
Data Needs to Achieve High-Performance Buildings
Identifying Universal Challenges

• **Performance Data**: Where are we now and where are we going?
• **Speaking the Same Language**: Can we communicate effectively?
• **Reaching Consensus**: Arriving at the same point but by different means
• **Shifting Perceptions**: Start with the desired outcome and then chart the path
• **Making Connections**: Demonstrating why it matters
• **It’s About People**: Human behavior and education are key
• **A Cast of Thousands**: Building by building and actor by actor
• **Changing Habits**: Can existing practices get us where we want to go?
Transition in the Design & Construction Industry

• New/better modeling tools needed to address design & operation connections
• Demonstrates importance of BIM and integrated design
• Component-by-component and discipline-by-discipline approaches will no longer produce the desired results. Contracting must reflect collaborative needs.
The Age of Measurement and Verification

• Results! Results! Results!
  – Desire (and ability) to detect problem areas
  – Reputations depend on results
    • Commissioning
    • Building Energy Labeling
    • Green Building Ratings
  – Flexibility, forensics, and foresight
  – Working in a collaborative environment
    • Integrated design
    • Design-Build{-Operate-Manage}
    • Building Information Modeling (BIM)
H. Green on “Green”

• A singular focus on “green” will get us buildings that meet the environmental needs, but risk unintended consequences.

• A holistic approach based on sustainability (social, economic and environmental) and resilience will provide the buildings that meet the needs of a diverse population.
  - USGBC/UM Report on Green Buildings and Resilience
  - DHS Integrated Resilient Design
The Facility Lifecycle

- Conceptual Design
- Detailed Design
- Analysis
- Documentation
- Visualization
- Building Information Modeling
- Programming
- Construction 4D/5D
- Fabrication
- Renovation
- Operation and Maintenance
- Construction Logistics
- Demolition

Courtesy of Autodesk
The NCEF website (www.ncef.org) is the largest source of school facilities information in the world. With over 21,000 resources, the site has hosted over 2 million visitors and 151 million hits. The site currently gets 1.5 million visits a year. NCEF is used by educators to research educational facility issues, by design and construction professionals as a technical resource, by state and local officials to inform their decision-making on school construction, and by citizens to help them understand issues affecting school facilities in their communities.

The value of the NCEF website is the timely and comprehensive access it provides to a multitude of educational facilities-related resources:
- Continuously updated materials: abstracts to quickly understand content, subject-specific bibliographies that organize the materials, and the searchable features that make these resources easily accessible to a broad audience.
- Quarterly reports and forecasts of U.S. school construction projects.
- A dedicated Green Schools webpage with current information on sustainable, energy-efficient, high-performance schools, colleges and universities.
- Key information on school facility safety and security issues, a video series on identifying safety vulnerabilities, and an online, customizable facility assessment tool.
- Important recent school facilities-related news from around the country.
- Six free publications produced by NCEF.
- A helpful directory of educational facilities-related professional organizations; federal, state and local agencies and organizations; academic research centers; and media resources.

NCEF ranks in the top ten for search engine results for most school facilities-related phrases such as: “green school buildings,” “school construction,” “early learning facilities,” “campus architecture,” “charter school facilities,” “school facility maintenance,” and “school facility financing.”

There is no single resource more valuable than NCEF to obtain information on best practices, benchmarking data, and innovative ideas for the more than $300 billion dollars that is spent annually to plan, design, build and operate education facilities in the United States.

NCEF is a program of the National Institute of Building Sciences, an IRS 501(c)(3) not-for-profit organization established by the U.S. Congress to serve as an authoritative and comprehensive source on building science and technology.

www.ncef.org
The National Institute of Building Sciences plans to form a multidisciplinary open committee later this year to explore how design of the built environment can affect the needs of the tens of millions of people with low vision in the United States. The Low Vision Design Committee is a direct outcome of the Workshop on Improving Building Design for Persons with Low Vision sponsored by the U.S. General Services Administration and the Institute last year. View proceedings of this workshop and related materials. The user name and password are both "lowvision" (one word, all lower case). To express an interest in joining the Low Vision Design Committee, send an email with your contact information to the Institute.
Owners Performance Requirements for the Building Enclosure

• To promote and incorporate increased true measurable high performance in the built environment through:
  – The adoption of enhanced security measures (including blast resistance) in concert with other high performance measures in the building envelope.
  – The development of a building owners tool to define high performance design measures and validation based on individual business cases and mission needs.
  – The development of testing protocols for the validation of high performance in building envelopes.
The OPR Tool is a web-based system that allows building owners to:

- Establish Performance-based Project Requirements for Building Owners
- Evaluate tradeoffs between high performance goals required and energy and environmental demands, threats, hazards, and building functions
- Establish performance goals that may range from minimum standards (baseline) to high performance solutions (benchmarks)
- Produces Owner Project Requirements that initiate the Commissioning Process in keeping with NIBS and ASTM standards

Note: Limited to Office Building Enclosures in this version
Owners Performance Requirements
Second Phase

- Extend Phase I (Enclosure) to cover Whole Building Functions for:
  - Architectural – Phase I + shading
  - Structural – add structure and foundations
  - Electrical – lighting and plug loads
  - Mechanical – add whole building load analysis

- Add coverage of Internal Demands and Threats
- Working with team from Phase I
- Completion by September 2012
Federal Building Personnel Training Act

• General Services Administration to:
  – Identify core competencies
  – Identify courses, certifications, licenses, degrees to demonstrate competencies
  – Develop a facilities management curriculum
  – Includes Contractors!

• Impacts on the entire industry:
  – A comprehensive collection of skills required for various building professionals
  – Will certainly find its way into private sector requirements
Record Number of $1 Billion Disasters

Billion Dollar Weather/Climate Disasters
1980 - September 2011
NOAA/NESDIS/NCDC

- Number of events per year that exceed a cost of 1 billion dollars in damages
- Actual damage amounts at the time of event
- Damage amounts adjusted to 2011 using the Consumer Price Index (CPI)
Government should endeavor to better understand the role of design and construction in infrastructure resilience. Application of this understanding will help to shape policy, R & D Funding, and incentives that can spur technological innovation as well as the robust design and construction of critical infrastructures needed for resilience.

The National Infrastructure Advisory Council, September 2009
Multihazard Mitigation Council

• Provides a focal point for the dissemination of credible information and counsel on major policy issues involving multihazard disaster resilience.

• Promotes increased all-hazard (man-caused and natural) disaster resilience in homes and commercial buildings.

• Promotes a whole building strategy that incorporates sustainability, security, and use of current and proven technological solutions.
Multihazard Mitigation Council

• Identifies and assesses building systems and software applications that play a critical role in disaster resilience and sustainability.

• Pursues funding in support of research and projects that relate to the MMC mission.

• Efforts directed to homeowners, businesses, schools, communities, public and private sector building portfolio managers, and many others.
Multihazard Mitigation Council

• Broad-based voluntary membership in the public and private sectors
  – Architects, engineers, contractors, risk assessment practitioners, trade and professional associations, materials interests, communities across the U.S.

• Organizational Members
  – Public: DHS, FEMA, USACE, GSA, VA, LLNB
  – Private: ASFPM, NFPA, USC
Moving Forward
Findings and Recommendations from the Consultative Council

An Authoritative Source of Innovative Solutions for the Built Environment
So What will it Take?

• High-Performance Paradigm
• Integrated holistic approach
• Life-cycle Analysis
• Measurement and Verification
• Dedicated industry team
• YOU!