2017 ANNUAL REPORT
TO THE PRESIDENT OF THE UNITED STATES

An Authoritative Source of Innovative Solutions for the Built Environment
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Letter to the President

Dear Mr. President:

Enclosed in this Annual Report to the President of the United States you will find an overview of everything the National Institute of Building Sciences accomplished in 2017. As shown throughout these pages, it was a year of growth and opportunity for the organization, with a focus on some of the highest priorities affecting the built environment.

During the year, the Institute embarked on several new initiatives designed to shape the future of the organization and set in place a plan to achieve even greater success by helping to advance building sciences in the building community and the nation.

The Institute examined its current strategic plan, which included a review of past strategic plans, an assessment of current activities and an evaluation of the organization’s role moving forward as we look to expand our efforts to implement the Institute’s mission in the building industry.

The Board of Directors reviewed the current strategic plan and, appreciating the important role the industry plays in the work of the Institute, made revisions in two areas. These include: strengthening the Institute’s ability to bring together key industry experts to identify and address emerging issues and seek solutions related to the built environment; and optimizing the Institute’s work across the public and private sectors to deliver products and services that serve the building industry.

The Institute’s councils, committees and work groups continued to take on new projects and initiatives in 2017. Because the results of the Institute’s actions have an impact on so many aspects of the built environment, we take a moment here to recognize the Institute’s members—the many subject matter experts and organizational representatives who have participated in Institute projects—to express our appreciation and gratitude for their involvement in the Institute and their dedication to improving building sciences.

Since its earliest days, the Institute leadership has understood that our membership is our greatest strength. In the second Annual Report to the President of the United States, then Institute Chairman David Miller and Institute President Gene Brewer stated, “All activities of the Institute will benefit from the depth and breadth of the advice and assistance that will soon be available, in full measure, from the Institute’s Consultative Council.” Since the initial establishment of the Consultative Council 40 years ago, the Institute has established a number of different councils to address the various fundamentals of construction. The Institute currently has 18 standing councils and committees that help us achieve our mission: “To serve the Nation and the public interest by supporting advances in building sciences and technology to improve the built environment.”

As you read this report, you will see how the Institute’s councils and committees endeavor to identify, plan and execute programs that meet organizational goals and move the Institute’s mission forward. Over the past several years, we have aligned our councils and committees to better address issues across multiple lines of discussion to improve the effectiveness and reach of their work and to gain broader acceptance throughout the building community. This cross-pollination has resulted in subject matter experts from distinct, even disparate, areas working together to tackle concerns that impact multiple facets of the building industry and our society at large. The resulting projects are more cohesive and more thoughtful, allowing the Institute to cooperatively and strategically expand its reach within the building community to address some of the most complex issues facing our communities and our nation as a whole.

Disaster mitigation was a major area of focus this year. Expanding on the original study, Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities, which the Multihazard Mitigation Council (MMC) released in 2005, the Institute wrapped up the first part of an expanded report in 2017, Natural Hazard Mitigation Saves: 2017 Interim Report. The team of experts will continue its work, with a second report scheduled to be ready for publication in late 2018.

The Council on Finance, Insurance and Real Estate (CFIRE) worked collaboratively with the MMC furthering resilience incentivization. During the year, CFIRE also examined how energy efficiency measures are accounted for in commercial mortgages.

In 2017, what was formerly known as the National Council of Governments on Building Codes and Standards, recognizing the important role private-sector stakeholders play in the
application and acceptance of codes and standards, dropped “Governments” from its title, making the council more expansive. The council released a white paper, The Role of Existing Building Codes in Safely, Cost-Effectively Transforming the Nation’s Building Stock, and worked on two other white papers that looked at including code officials earlier in the design process and the benefits of a timely code adoption cycle.

At Building Innovation 2017: the National Institute of Building Sciences Fifth Annual Conference & Expo, the Institute debuted the first guide to help owners implement building information modeling (BIM) for their buildings. The result, the National BIM Guide for Owners, was developed by a multidisciplinary team of experts from various stakeholder groups. The guide addresses how building owners and their design teams can create a BIM for use throughout the life span of a facility, from planning and occupancy to maintenance and repurposing.

The Institute also celebrated 20 years of the WBDG Whole Building Design Guide® in 2017. Over the past two decades, the WBDG has sustained itself as an important industry tool and expanded to become one of the largest online repositories of building information in the world. This online portal is an amazing resource that provides information, continuing education, case studies and more to advance the building community and the public’s understanding of this work.

The Institute and the Green Sports Alliance, seeking ways to reduce water and energy consumption in stadiums and arenas, finalized its research and completed the report, Taking the Field: Advancing Energy and Water Efficiency in Sports Venues.

The Off-Site Construction Council initiated activities with The American Institute of Architects (AIA) and the Construction Specifications Institute (CSI) to develop joint guidance to facilitate the effective utilization of off-site construction.

The Building Seismic Safety Council, under the sponsorship of the Federal Emergency Management Agency (FEMA), continued to develop the 2020 Recommended Provisions for New Buildings and Other Structures for the National Earthquake Hazards Reduction Program. This cross-disciplinary council, with its team of subject matter experts, works to improve the resilience of our built environment through effective measures to limit damage from earthquakes.

The Institute’s Consultative Council, as established in the enabling legislation, includes a broad base of agencies and organizations knowledgeable in the field of building technology. Each year, these representatives from private, trade, professional and labor organizations; private and public standards, code and testing bodies; public regulatory agencies; and consumer groups provide guidance and recommendations regarding some of the building industry’s most pressing concerns. The 2017 report, Moving Forward: Findings and Recommendations from the Consultative Council, which can be found at the end of this Annual Report, explores how the building industry can and should evolve to meet the changing needs of society and how new technologies and practices can attract a 21st century workforce.

As demonstrated by these and other activities highlighted in this Annual Report, the Institute has achieved much in the past year, and our strategy, working across councils and with greater engagement from the building community, has proven to be effective and productive.

By involving multiple segments of the building industry, from designers and constructors to material producers, suppliers and academia, the Institute continues to be a leading force in addressing the most demanding issues facing our built environment. By tackling these concerns in a collaborative way, we are able to improve efficiencies, avoid duplicative efforts and help make our nation’s buildings ready for the next challenge. We stand ready to assist in continuing to improve the strength and performance of the nation’s built environment.

It is our distinct honor to present this Annual Report for your consideration.

Sincerely,

Stephen T. Ayers, FAIA, LEED AP
Chairman, Board of Directors

Henry L. Green, Hon. AIA
President
About the Institute

The U.S. Congress established the National Institute of Building Sciences in 1974 to bring the public and private sectors together to address building science and technology-related issues to make buildings safer and better performing. For more than 40 years, the Institute has gathered the industry together to tackle numerous challenges and find effective solutions. Today, the Institute continues to provide the opportunity for free and open discussion of issues and problems where there was once conflict and misunderstanding. It continues to assemble federal, state and local government agencies and representatives of the private sector for open working sessions that seek a consensus solution to problems of mutual concern. The Institute also works with federal agencies on projects related to the built environment to help achieve national goals.

The Institute's 21-member Board of Directors is composed of 15 elected members and six members appointed by the President of the United States subject to the approval of the U.S. Senate. Headquartered in Washington, D.C., the Institute's professional staff provides technical, managerial and administrative support for the Institute's programs.

The Institute Board of Directors

The National Institute of Building Sciences Board of Directors is comprised of 21 members. Six members are appointed by the President of the United States, with the advice and consent of the U.S. Senate, to represent the public interest. The remaining 15 members are elected and can represent either public interest or industry voices. The Board representation includes architects, builders, building owners, building standards developers, consumers, contractors, educators, fire safety professionals, insurance representatives, local agency officials, product manufacturers, professional engineers, state agency officials and others. However, the majority of Board members are required to come from the public interest category.

In 2017, the Board’s Executive Team included Stephen T. Ayers, FAIA, LEED AP, the Architect of the U.S. Capitol, as chair; Joseph Donovan, senior vice president at Beacon Capital Partners, as vice chair; Joy Marshall Ortiz, AIA, NCARB, executive vice president of The Marshall Group, as secretary; and Wally E. Bailey, director of development services for the City of Fort Smith, Arkansas, as treasurer.

Three new members were elected to the Board in 2017. Lane J. Beougher, FAIA, FCSI, LEED AP BD+C, Ohio Facilities Construction Commission, Columbus, OH; Brian E. Garbecki, PE, LEED AP, Gilbane Building Company, Boston, MA; and Donald L. Pratt, Construction Education & Consulting Services of Michigan, Auburn Hills, MI were honored, upon completing their Board service in 2017, for their contributions to the Institute and the building industry.

2017 Board of Directors

Chair: Stephen T. Ayers, FAIA, LEED AP, Architect of the Capitol, Washington, DC
Vice Chair: Joseph B. Donovan, Beacon Capital Partners, Arlington, VA
Secretary: Joy Marshall Ortiz, AIA, NCARB, The Marshall Group, Ltd., Reston, VA
Treasurer: Wally E. Bailey, CBO, City of Fort Smith, AR

Lane J. Beougher, FAIA, FCSI, LEED AP BD+C, Ohio Facilities Construction Commission, Columbus, OH; Paul R. Bertram, Jr., FCSI, CDT, LEED AP, GGP, PRB Connect, Casselberry, FL; Cindy L. Davis, Virginia Department of Housing and Community Development, Richmond, VA; Anne M. Ellis, PE, FACI, FASCE, Anne Ellis, LLC, McLean, VA; Cheryl R. English, FIES, IC, Acuity Brands, Conyers, GA; Richard B. Hayter, PhD, PE, FASHRAE, Ret., Kansas State University, Manhattan, KS; Carl Hedde, Munich Reinsurance America, Inc., Princeton, NJ; Thomas Izbicki, PE, FSFPE, Rolf Jensen & Associates, Inc., Plano, TX; James “Tim” Ryan, CBO, City of Overland Park, KS; Thomas L. Mitchell, Jr., USAF, CFM, CFMJ, IFMA Fellow, FMIS Associates, LLC, San Antonio, TX; Susan A. Maxman, FAIA, Green Cove Springs, FL; Thomas L. Mitchell, Jr., USAF, CFM, CFMJ, IFMA Fellow, FMIS Associates, LLC, San Antonio, TX; Donald L. Pratt, Construction Education & Consulting Services of Michigan, Auburn Hills, MI; James “Tim” Ryan, CBO, City of Overland Park, KS; James Timberlake, FAIA, KieranTimberlake, Philadelphia, PA; and Mary B. Verner, MES, JD, Washington State Department of Natural Resources, Olympia, WA.
Membership

Without the commitment of its membership, the National Institute of Building Sciences simply could not accomplish its mission to improve the built environment by advancing building science and technology. Representing all disciplines of the building community, Institute members lend their expert knowledge and first-hand experiences toward the development of sound solutions to better the industry. They generously contribute their time and energy to serve on the Institute’s boards, councils, committees and projects in support of the Institute’s work. Members represent government agencies, design professionals, the construction industry, software developers, manufacturers, insurers, educators, researchers and others. With their support and active participation, the Institute successfully serves as the industry’s leader and advocate for the construction and maintenance of safe and sustainable buildings and communities. Their accomplishments over the past year are documented throughout the pages of this Annual Report.

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2017 Annual Institute Awards

Each year, the National Institute of Building Sciences recognizes individuals and organizations that have provided outstanding service to the Institute, the building community and the nation. The 2017 nominees include a project team member, an Institute committee, the leader of an industry association and a past chair of the Institute’s Board of Directors.

The Institute Member Award goes to a member of the Institute who has made a substantial contribution in support of the mission, goals and objectives of the organization. The 2017 Member Award recognizes M. Dennis Knight, PE, for his work on developing the Institute’s building information modeling (BIM) guide geared toward building owners, the National BIM Guide for Building Owners (NBGO), released in January 2017. Founder and chief executive officer of Whole Building Systems, Knight was a member of the NBGO Project Team.

In keeping with the Institute’s abiding tenets to bring all stakeholders to the project table, Knight contributed significantly to integrating the disparate skills and interests of this multidisciplinary team into a coherent product that was downloaded more than 1,300 times in the first six months of its availability. He also contributed a large share of content to the “Infrastructure and Standards” section of the NBGO, and kept the concept of employing standards foremost in the team’s awareness. As an ASHRAE fellow and director at large, as well as a member of ASHRAE’s Steering Committee for BIM, Knight has been instrumental in promoting the work of the Institute beyond its boundaries. Recently, he contributed significantly to ASHRAE’s efforts to promote the NBGO to an American National Standards Institute (ANSI) standard; ASHRAE has since filed a project initiation notice with ANSI for this effort.

The Institute Honor Award goes to individuals or groups who have made an exceptional contribution to the nation and the building community. The 2017 Honor Award recognizes the WBDG Whole Building Design Guide® Advisory Committee. The WBDG marked its 20-year anniversary in 2017, and the WBDG Advisory Committee is largely responsible for that success. From a handful of pages, the WBDG site was developed to incorporate knowledge across a wide range of design, construction and management topics. Today, the WBDG hosts hundreds of pages and educational courses containing information applicable to all aspects of a facility from the ‘whole building approach’. The site also hosts much of the federal-sector criteria, making it one of the largest information portals in the industry visited by thousands of people each month across the federal, private and educational sectors. Consisting primarily of federal agency representatives, the committee has continued to support the project through the years. The group’s dedication is commendable, and the reason the Institute recognized the Advisory Committee with the 2017 Honor Award.

The Institute President’s Award is given to an individual or organization in recognition of extraordinary efforts to assist in advancing the mission of the Institute. Building Owners and Managers Association (BOMA) International President and Chief Operating Officer Henry H. Chamberlain is recognized for his support over the years; guidance and assistance in developing the Institute’s Conference; and the recent endeavor to create the National BIM Guide for Owners.

“From the moment I arrived in our Nation’s Capital, you have provided me with insightful assistance and a listening ear,” wrote Green in his announcement letter to Chamberlain. “The relationship forged over the past nine years between our organizations will long stand as a testament to the work of two organizations that share a common interest in improving the built environment. I will always cherish this as a hallmark of my success in Washington.”

The Mortimer M. Marshall Lifetime Achievement Award, the Institute’s highest honor, goes to someone who has demonstrated a lifetime of dedication to the mission and goals of the Institute. Established in 2011 and named after the organization’s first member, this award is bestowed upon those who exhibit the passion upon which the Institute is founded. The Mortimer M. Marshall Lifetime Achievement Award goes to James “Tim” T. Ryan, CBO, who recently retired as code administrator for the City of Overland Park, Kansas.

Ryan has served on the Institute’s Board of Directors for more than a decade. Initially elected to a Board seat in 2006, Ryan served two full terms. He was then nominated by President Obama in 2012 and confirmed by the Senate to serve on the Board as a presidential appointee. Over the years, Ryan served as secretary, vice chair and as chairman. He also chaired of the Coordinating Council; was liaison to the Multihazard Mitigation Council and the BRIK Building Research Information Knowledgebase; and sat on the Executive Committee, Nominations Committee, Annual Report Committee, Awards Committee and the Strategic Planning Committee. Ryan served on the Institute committee that reviewed the National Institute of Standards and Technology (NIST) report on the World Trade Center collapse. He served as an advisor following Hurricane Katrina on damage assessment and mitigation efforts, and performed damage assessments following tornados in Greensburg, Kansas in 2007, and Chapman, Kansas in 2008.

In December 2017, Ryan retired from the Overland Park, where he worked for three decades, joining as a field inspector in 1978. He is a certified building official with 15 separate certificates, and a voting member of the International Code Council, the International Association of Electrical Inspectors and the National Fire Protection Association. Ryan chaired the Steering Committee for the State of Kansas tasked with creating a program to oversee the energy code provisions of the American Recovery and Reinvestment Act. He is a certified member of the Kansas Damage Assessment Team and served as president of the Kansas City Construction Users Council. Ryan’s decades of participation demonstrate his long commitment to the goals and mission of the Institute and exemplify the purpose of the Marshall Award.

The Institute will celebrate its 2017 award winners at an Annual Awards Dinner, to be held January 10, 2018, during Building Innovation 2018: The Institute’s Sixth Annual Conference and Expo, at the Mandarin Oriental in Washington, D.C.

Earlier in 2017, the Institute issued a call to industry for nominations to identify potential award recipients. The Awards Committee reviewed the submissions and selected winners from the nominees, based on how their work meets the mission, objectives and goals of the Institute.

The Awards Committee will solicit nominations for 2018 awards in late spring of 2018, with nominations due in July.
INDUSTRY LEADERSHIP & ADVOCACY
Coordinating Council

The Coordinating Council meets several times a year to share updates on projects and discuss activities of the standing councils and committees. The meetings, held in tangent with the National Institute of Building Sciences Board of Directors meetings, give the members, consisting of the leaders of each of the Institute’s standing councils and committees, and members of the Board of Directors an opportunity to communicate about their activities and share ideas for potential collaboration across Institute projects and council activities.

The Institute’s councils and committees consist of professionals from a wide range of fields. The Coordinating Council provides an assembly point for these experts from different industries and backgrounds—who may not interact in their daily careers—to meet and discuss mutual concerns, keep apprised of each group’s efforts and provide input on Institute projects. In 2017, the Coordinating Council served as the meeting ground for the Multihazard Mitigation Council and the Council on Finance, Insurance and Real Estate to discuss disaster mitigation. The assembly of the group also triggered a discussion about winding down the Sustainable Buildings Industry Council and the High Performance Building Council, since other Institute programs and building industry organizations had taken up their missions.

Looking Ahead

In 2018, the Coordinating Council will meet throughout the year to discuss program activities and collaborate on mutual areas of interest.

Learn More

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Consultative Council

Throughout the year, the Consultative Council developed the 2017 Moving Forward Report, which featured findings and recommendations to the President and U.S. Congress that focus on the building industry of the future. The report, which will be released during the council’s Annual Meeting at Building Innovation 2018, is included at the end of this Annual Report. In 2017, the Consultative Council also conducted outreach activities associated with the 2016 report, including a Congressional briefing during High-Performance Building Week, and generated related fact sheets on 2016 directives to advance the building workforce and address waterrelated issues.

Looking Ahead

The Consultative Council will release its 2017 report during Building Innovation 2018 and will continue its outreach through Congressional briefings and other outlets. The Council also will begin developing the 2018 Moving Forward Report, with an intended release during Building Innovation 2019.

Learn More

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Council Leadership

Chair: Bob Horner, Illuminating Engineering Society
Vice-Chair: Vicki Worden, Green Building Initiative
Secretary: Wanda Edwards, RCI
Low Vision Design Committee

The Low Vision Design Committee (LVDC) extended its outreach efforts throughout 2017, speaking nationally to national conferences of The American Institute of Architects (AIA) and Environments for Aging, as well as to local design and advocacy groups. LVDC members Vijay Gupta and Institute President Henry L. Green also delivered a presentation at the 100th Anniversary Celebration conference of the International Lions Club, held in Chicago in July. The LVDC works to fulfill its mission to address the needs of all occupants of the built environment, including those with low vision, through improvements in designs and operational procedures for new and existing facilities to enhance the function, safety and quality of life by identifying relevant knowledge—and research gaps—and sharing that knowledge through the creation and refinement of design guidelines and building standards, including its seminal Design Guidelines for the Visual Environment.

Looking Ahead

In 2018, the LVDC will offer presentations at the Environments for Aging Expo & Conference in Savannah in April and the AIA National Convention in New York City in June. The group will continue to pursue conversion of its guideline into a national standard.

Learn More

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Committee Leadership

Chair: Edward L. Soenke, AIA, The Design Partnership
Vice Chair: Stuart Knoop, FAIA, OKKS Studios (retired)
Institute Board Liaison: Cheryl R. English, FIES, LC, Acuity Brands

Off-Site Construction Council

The Off-Site Construction Council (OSCC) continued to support increased knowledge-sharing within the building industry to advance utilization of off-site construction technologies. The OSCC undertook an initiative to produce a series of documents to summarize the content of its 2016 webinar series, to be released in early 2018. The council also initiated activities with The American Institute of Architects (AIA) and the Construction Specifications Institute (CSI) to develop joint guidance to facilitate the effective utilization of off-site construction. In addition to its January meeting during Building Innovation 2017, the council met in March during World of Modular in Tucson, Arizona. Later in the year, the OSCC conducted follow-up surveys of both educators and building professionals to get an update on how the industry is using and how academics are teaching about off-site construction since its 2014 surveys.

Looking Ahead

In 2018, the OSCC will release additional implementation resources, including summaries of its 2016 webinar series and results from its surveys of academics and industry. The council will continue dialogues with AIA and CSI, and expects to release guidance documents in late 2018. The OSCC plans to hold meetings during Building Innovation 2018, the World of Modular and at the Off-Site Construction Expo.

Learn More

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Council Leadership

Chair: Susan Klawans, Gilbane Building Company
Vice-Chair: Tom Hardiman, Modular Building Institute
Secretary: Laurie Robert, NRBC
Institute Board Liaison: Thomas Izbicki, PE, FSFPE, Jensen Hughes
Jacinda Collins, American Institute of Steel Construction
Dean Frank, Precast/Prestressed Concrete Institute
Brad Guy, Catholic University of America
George Lea, U.S. Army Corps of Engineers
Dan Nyce, Oldcastle
Allen Post, Perkins & Will
RJ Reed, Whiting Turner
Stacy Scopano, Skanska
Ryan Smith, University of Utah
Jay Sztuk, Department of Veterans Affairs
National Council on Building Codes and Standards

In January, the National Council of Governments on Building Codes and Standards released a white paper, *The Role of Existing Building Codes in Safely, Cost-Effectively Transforming the Nation’s Building Stock*, at Building Innovation 2017. During the year, the council, recognizing the importance of involving both the public and private sectors in advancing codes and standards and their application, altered the makeup of its board of direction to include private-sector stakeholders and dropped “Governments” from its title. Now known as the National Council on Building Codes and Standards (NCBCS), the council also began work to coordinate code change proposals for the *International Existing Building Code* (IEBC), for consideration in 2019. Additionally, the council worked to finalize two white papers, *Engaging Code Officials Early in the Process to Achieve High-Performance Buildings and Benefits and Challenges of a Timely Code Adoption Cycle*, to be released in early 2018.

**Looking Ahead**

In 2018, the NCBCS plans to release the two white papers at Building Innovation 2018; continue to coordinate the development of consensus code change proposals to the IEBC; and develop a new white paper on the role of the code officials and code departments in disaster preparation and recovery. Given that the *Natural Hazard Mitigation Saves 2017: Interim Report* has a significant focus on building codes as a means to achieving mitigation, the council also will look to leverage that work in communicating the value of building codes.

Learn More

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Council Leadership

**Chair:** Henry Kosarzycki, State of Wisconsin, Department of Health Services

**Vice-Chair:** Bill Koffel, Koffel Associates

**Secretary:** Jonathan Flannery, American Society for Healthcare Engineering

**Institute Board Liaison:** Cindy Davis, Virginia Department of Housing & Community Development

Stephen Jones, Millburn Township, New Jersey

Scott McDonald, Department of Development Services, City of Denton, TX

Emory Rodgers, Virginia Building Officials Association

Commercial Workforce Credentialing Council

In 2017, the National Institute of Building Sciences, through its Commercial Workforce Credentialing Council (CWCC), continued to support the U.S. Department of Energy (DOE) Better Buildings Workforce Guidelines (BBWG). During the year, the Institute and DOE welcomed three more accredited BBWG jobs: Certified Building Energy Assessment Professional (BEAP) and Certified Building Commissioning Professional (BCxP), submitted by ASHRAE, and Certified Commissioning Authority (CxA) from the AABC Commissioning Group. In addition, the Institute conducted outreach and support to generate interest in use of BBWG jobs in the public and private sectors. The CWCC also developed accreditation requirements for a Blast Protection (BP) Professional Job Task Analysis (JTA) under a grant from the U.S. Department of Defense (DOD) Combating Counter-Terrorism Technical Support Office (CTTSO).

**Looking Ahead**

The CWCC will continue to support the DOE BBWG program in 2018, working on outreach with the public and private sectors and coordinating with credentialing bodies on BBWG certifications and certificates. The CWCC will complete its DOD CTTSO work and release the JTA and accreditation scheme for Blast Protection (BP) Professionals and work with a credentialing body to offer a BP certification.

Learn More

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Board of Direction

Jonathan Flaherty Tishman Speyer
Brian Gilligan, U.S. General Services Administration
Don Gilligan, National Association of Energy Service Companies (NAESCO)
Jerry Kettler, Facility Performance Associates
John Lee, New York City Mayor's Office
Kim Lenihan, New York State Energy Research and Development Authority
Doug Lewin, The South-central Partnership for Energy Efficiency as a Resource
Elizabeth O'Herren, U.S. Department of Homeland Security
Paul Rode, Related Companies
Caroline Sarno, Northeast Energy Efficiency Partnership (NEEP)
Priya Swamy, U.S. Department of Energy
Science, Technology, Engineering and Mathematics Education Program

Interactive Mars City Facility Operations (Ops) Challenge

The cornerstone project of the National Institute of Building Sciences (NIBS) Science, Technology, Engineering and Mathematics (STEM) Education Program, the Mars City Facility Operations (Ops) Challenge, continued to take shape in 2017. During the year, the joint NIBS –Total Learning Research Institute (TLRI) project development team presented the initiative to several industry groups interested in developing the future workforce. The team began making preparations to support the full integration of the program online. Staff also began coordinating with other building industry organizations to arrange a Building Sciences Pavilion at the 2018 USA Science and Engineering Festival in Washington, D.C.

Looking Ahead

The STEM Program will host a booth at the 2018 USA Science and Engineering Festival, where staff and volunteers will present a virtual reality walkthrough of the Mars City base. Staff will continue working with other members of the Building Sciences Pavilion to develop common messaging and promotion of the online Building Sciences Career Center available on the WBDG Whole Building Design Guide® website. Additionally, the project team will continue developing the Mars City Facility Ops Challenge, adding functionality and integration across the program’s various components.

Learn More
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Website: www.nibs.org/STEM and www.nibs.org/MarsCity

STEM Leadership
Lead Organizations:
National Institute of Building Sciences
Total Learning Research Institute
National Aeronautics and Space Administration

Technical Support:
Alderson Engineering
Autodesk
Gilbane Building Company
International Facility Management Association
Jacobs Engineering
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TMA Systems
Tipps Architecture
Throughout 2017, the Council on Finance, Insurance and Real Estate (CFIRE) continued its collaboration with the Multihazard Mitigation Council (MMC) to identify public- and private-sector incentives that will increase investment in hazard mitigation. CFIRE members also provided feedback as key stakeholders during the development of the expansion and update to the *Natural Hazard Mitigation Saves* study, for which the final report will be released in late 2018. In September, the council hosted a webinar with the U.S. Department of Energy on how energy efficiency measures are accounted for in commercial mortgages.

**Looking Ahead**

In 2018, the council will continue working with MMC to develop a framework for a resilient mortgage. Additional focus areas include the valuation of renewable energy systems and the incorporation of resilience and energy efficiency measures into the insurance and financial underwriting process.

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### Academy for Healthcare Infrastructure

In January 2017, the Academy for Healthcare Infrastructure (AHI)-led effort to offer a forum themed “Creating a High-Performing Environment for Healthcare” at Building Innovation 2017 resulted in a number of highly regarded presentations, including “Understanding Key Design Strategies that Impact Patient Outcomes,” by Ellen Taylor and “Engaging the City of Chicago in Creating a ‘World-Class’ Children’s Hospital,” by Bruce Komiske. In August, members of the Academy took part in a representative hearing sponsored by the Maurice L. and Hulda B. Rothschild Foundation, to gather feedback from relevant stakeholders on “Facility-Based Requirements for the Delivery of Person-Centered Care,” with keynote speakers Stella Fiotes, Executive Director, Office of Construction and Facilities Management, U.S. Department of Veterans Affairs, and Stephen C. Wooldridge, PhD, PE, FACHE, Vice President, Integrated Real Estate & Facility Services, MedStar Health.

**Looking Ahead**

In 2018, the Institute will distribute a report detailing the findings and recommendations from the representative hearings for transmission to Congress; federal and state agencies; policymakers; codes and standards developers; healthcare providers; and other building industry stakeholders.

**Learn More**

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### Rothschild Foundation Executive Director Margaret Calkins (podium) addresses the AHI Listening Panel as keynote speakers Stephen C. Wooldridge and Stella Fiotes look on.

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### AHI Research Governors

- Frank Aucremanne, Cleveland Clinic Foundation
- Clayton Boenecke, U.S. Department of Defense Military Healthcare System
- Robert F. McCoole, Ascension Health
- Robert Mitsch, Sutter Health
- Gregory Mohler, BJC Healthcare
- Spencer Moore, MD Anderson Cancer Center
- Judy Quasney, National Institutes of Health
- Skip Smith, Catholic Health Initiatives
- Dana E. Swenson, UMass Memorial
- Denton Wilson, Methodist Health System
- Stephen C. Wooldridge, MedStar Health
- Don Wojtkowski, SSM Health

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### Council Leadership

Chair: Lindene Patton, Earth and Water Law

Vice-Chair: Erin Rae Hoffer

Secretary: Michael Zimmer, Ohio University

Institute Board Liaison: Carl Hedde, MunichRe

Debra Ballen, Insurance Institute for Business & Home Safety

Andrew Dorchester, The Dorchester Group

James Finlay, SoundView Risk Advisors

Rothschild Grant, State Farm

Steve Orlovski, Building Owners and Managers Association Intl.

Leanne Tobias, Malachite

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**Learn More**

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SECURITY & DISASTER PREPAREDNESS
In 2017, the Building Seismic Safety Council (BSSC), under the sponsorship of the Federal Emergency Management Agency (FEMA), continued to develop the 2020 Recommended Provisions for New Buildings and Other Structures for the National Earthquake Hazards Reduction Program (NEHRP). The Provisions Update Committee (PUC) hosted three meetings and oversaw the work of nine issue teams. The PUC conducted two ballots: one to adopt the current American Society of Civil Engineers (ASCE)/Structural Engineering Institute (SEI) 7-16 standard as the primary reference for the 2020 NEHRP Provisions and the other on seven technical proposals from the issue teams. As a follow-up to the 2015 NEHRP Provisions, the BSSC presented seven live webinars and conducted sessions at the 2017 Structural Engineers Association of California (SEAOC) Convention and the 2017 National Council of Structural Engineers Associations (NCSEA) Structural Engineering Summit. In addition, BSSC’s Project 17 Committee (P17C), under the sponsorship of FEMA and coordinated with the U.S. Geological Survey (USGS), held three meetings; oversaw efforts of five work groups to develop guidelines for the next generation of seismic design value maps; and conducted an April workshop to solicit input from the seismic community.

Looking Ahead

In 2018, the BSSC Issue Teams will develop proposals; PUC will conduct ballots; and Member Organizations will begin balloting proposals approved by the PUC. The P17C will conclude its work on the seismic maps. BSSC will host an on-demand series of webinars based on the 2015 Provisions. The BSSC also will conduct sessions on the progress on the 2020 Provisions at the 11th National Conference on Earthquake Engineering and Structures Congress 2018.

Scientific Resolution Panel

In 2017, the National Institute of Building Sciences continued its Scientific Resolution Panel (SRP) work with the Federal Emergency Management Agency (FEMA). During the year, the Institute expanded its subject matter expert (SME) database to include more hydraulic engineer experts. The Institute convened an SRP for Rockingham County, New Hampshire, in FEMA Region I, to review technical data submitted by the community appealing a FEMA coastal map for the Town of Rye. The SRP presented its Town of Rye decision and report to FEMA in February of 2017.

Looking Ahead

In 2018, the Institute will continue to convene SRPs on an as-needed basis to address community appeals and/or FEMA concerns.
Multihazard Mitigation Council

In January, during Building Innovation 2017, the Multihazard Mitigation Council (MMC) delivered two presentations: the first on incentivizing resilience and the second on a reexamination of its 2005 Natural Hazard Mitigation Saves study. An Institute team consisting of members from the MMC began working on a new expanded study (see the Mitigation Saves section), and prepared an Interim Report of the initial results. The winter issue of the Journal of the National Institute of Building Sciences (JNIBS) included an MMC article, “Resilience Mortgages: Supporting Mitigation through Incentivization,” which described the first step in creating a comprehensive public-private approach for supporting mitigation. The MMC also worked with the Council on Finance, Insurance and Real Estate (CFIRE) to draft documents describing an innovative resilience mortgage concept that incorporates financing for hazard mitigation into the primary mortgage, and features a positive benefit-cost ratio for both the borrower and lender supported by mortgage, insurance and tax incentives. Over the course of the year, the MMC periodically visited with staff of the U.S. House of Representatives Committee on Transportation and Infrastructure Subcommittee on Economic Development, Public Buildings and Emergency Management to provide updates on Mitigation Saves and discuss incentivization efforts.

Looking Ahead

In 2018, the MMC will unveil Natural Mitigation Saves 2017: Interim Report at Building Innovation 2018; share the findings at other venues throughout the year; and continue to gain funding for the Mitigation Saves study, especially for business continuity and non-building federal programs. To further support dissemination of the Mitigation Saves findings, the MMC Communications Committee will develop webinars, presentations and one-pagers targeted to disaster community stakeholders, including insurers, financiers, local officials and others. The MMC and CFIRE also will work with the housing, mortgage and insurance communities on the framework for a residential resilience mortgage.

Learn More

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Council Leadership

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Vice Chair: Bryan Koon, Florida Division of Emergency Management
Secretary: Keith Porter, University of Colorado at Boulder
At Large: Nancy McNabb, The Continuity Project
At Large: Sara Yerkes, International Code Council
Institute Board Liaison: Timothy H. Haahs, PE, AIA, Timothy Haahs & Associates

SAFETY Act for Commercial Facilities

In 2017, the National Institute of Building Sciences continued its work under contract with the U.S. Department of Homeland Security (DHS) Science & Technology (S&T) Office of Safety Act Implementation (OSAI). After completing the initial process in 2016, the Institute worked to implement the process for conducting assessments of commercial facilities to meet the Support Anti-terrorism by Fostering Effective Technologies Act of 2002 (SAFETY Act) application requirements and added a training component. The Institute also completed refinements to the Best Practices for Anti-Terrorism Security (BPATS) assessment tool for commercial facilities and accompanying user manuals, and began developing an online training program to help assessors and building owners conduct facility assessments using the BPATS. Commercial facility owners can utilize the best practices to assess exposure of their buildings to a terrorist attack. The results can be used as part of an application for coverage under the SAFETY Act as described on the DHS website.

Looking Ahead

In 2018, the Institute anticipates working with DHS to release the BPATS Tool, provide training in its use and support the application process for commercial facility owners and assessors.

Learn More

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Natural Hazard Mitigation Saves

In 2017, the project team responsible for updating and expanding the 2005 study, *Natural Hazard Mitigation Saves: An Independent Study to Assess the Future Savings from Mitigation Activities*, continued its research. The team conducted a workshop in February with the project oversight committee and key stakeholders to review its benefit-cost analysis (BCA) methodology. In May, the committee reviewed the initial results. In August, the oversight committee and stakeholders reviewed a final draft of the *Interim Report*. The project team delivered an internal report to Federal Emergency Management Agency (FEMA) in September, and prepared the public report, *Natural Hazard Mitigation Saves: 2017 Interim Report*, for release in January 2018. The team found the impacts of 23 years of federal mitigation program grants by FEMA, the Economic Development Administration (EDA) and the Department of Housing and Urban Development (HUD) resulted in a national benefit of $6 for every $1 invested. Designing new construction to exceed select provisions in the 2015 *International Building Code* (IBC) and the 2015 *International Residential Code* (IRC) and implementing the 2015 *International Wildland-Urban Interface Code* (IWUIC) resulted in a national benefit of $4 for every $1 invested. During the year, the team also initiated a BCA of mitigation strategies for infrastructure and analyzed the cost effectiveness of disaster mitigation efforts for wind, flood, earthquake and wildfire.

Looking Ahead

The Institute will publicly release *Natural Hazard Mitigation Saves: 2017 Interim Report* during Building Innovation 2018 in January. Throughout the year, the project team will complete the BCA for infrastructure; initiate analysis of retrofits; and look at the benefits of going from low or no code to adopting the 2015 IBC.

Learn More

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Integrated Rapid Visual Screening

As it has done since 2011, the National Institute of Building Sciences continued to support the Integrated Rapid Visual Screening (IRVS) tool in 2017. In that role, the Institute provides the IRVS Interagency Security Commission (ISC) version to federal agencies upon request and related support as needed. The Institute also continued its work with the U.S. Department of Homeland Security (DHS) Science and Technology Directorate (S&T) on an agreement to allow the Institute to make all versions of IRVS, including the IRVS for Buildings, Mass Transit Stations and Tunnels; the IRVS ISC; and the IRVS for Schools, available to government and private-sector users.

Looking Ahead

The Institute expects to reach agreement with DHS on the long-term plan for IRVS. Once it is in place, the Institute plans to seek support from users to update, resume development and continue providing IRVS in its various forms to public and private sector organizations.

Learn More

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FACILITY PERFORMANCE & SUSTAINABILITY
In 2017, Building Enclosure Technology and Environment Council (BETEC) members continued to work together to share knowledge of existing and new technologies and practices, and to integrate technical programs on building safety, durability, resilience and occupant comfort with the thermal performance of building envelopes. The Building Enclosure Councils (BECs), a joint venture between The American Institute of Architects (AIA) and the National Institute of Building Sciences (NIBS) under the aegis of BETEC, host some 4,000 members in 33 chapters across the country. With BETEC as a sponsor and BEC-Detroit as a host, the BECs presented the BEC National Conference in Detroit on October 17, to some 200 participants. Meanwhile, planning continued on the fifth BEST Building Enclosure Science and Technology Conference™ (BEST5), to be held in Philadelphia, Pennsylvania, in April 2018. BETEC members also contributed articles for the Autumn building enclosure design-focused issue of the Journal of the National Institute of Building Sciences (JNIBS), themed "Perfecting the Building Enclosure."

Looking Ahead

In April 2018, BETEC will host the BEST5 in Philadelphia. At BEST5, BETEC will launch its first three modules, leading to a joint ASTM/NIBS certificate in building enclosure commissioning (BECx). In addition, BETEC members will seek authors to update sections of the Building Envelope Design Guide, part of the Institute's WBDG Whole Building Design Guide® website.

Learn More

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Council Leadership

Chair: Theresa Weston, PhD, Technical Fellow, DuPont Building Innovation
Vice Chair: David Herron, AIA, Principal, herron + partners
Secretary: Stephen Shanks, Chief Operating Officer, CTI Consultants, Inc.
Member at Large: Wagdy Anis, FAIA, Principal, Anis Building Enclosure Consulting
Member at Large: Rockford Boyer, Technical Manager, Building Enclosure, Elastochem Specialty Chemicals Inc.
Past Chair: Judd A. Peterson, AIA, Director of Building Science, Judd Allen Group
Institute Board Liaison: Paul R. Bertram, Jr., FCSI, CDT, LEED AP, GGP, PRB Connect
In 2017, the National Institute of Building Sciences assisted the U.S. Department of Defense (DOD) Defense Health Agency (DHA) with technical support to enhance the facility budget cost models of its real property portfolio. The Institute guided DHA on its Capital Improvement Decision Model (CIDM 5.0 – 6.0) process. In addition, the Institute team developed recommendations relating to project management; execution, including military construction (MILCON); sustainment; restoration; and modernization. The tasks led to strategic planning for future policy adoption.

Looking Ahead

In 2018, the Institute will continue working on newly awarded task orders that facilitate DHA’s initiative to share data with other federal agencies and consider life-cycle management principles in sustaining and maintaining medical facilities. The Institute expects to begin a DHA Commissioning pilot program by the end of the year.

Learn More
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Advancing Energy and Water Efficiency in Stadiums and Arenas

One year after a team from the National Institute of Building Sciences and the Green Sports Alliance began working with the U.S. Department of Energy to look at reducing water and energy use in stadiums and arenas, the project is now complete. The report, Taking the Field: Advancing Energy and Water Efficiency in Sports Venues, considers the potential water and energy reductions the U.S. sports sector could make, and highlights the financial savings some leagues and teams are already seeing from putting such efficiency initiatives into place. The project team released its final report in February 2017 during the 43rd Annual Stadium Managers Association Seminar in Huntington Beach, California.

Over 240 million fans visit sports venues annually. Sports teams and clubs employ nearly 60,000 people and generate $22.6 billion in annual revenue. Total square footage of these facilities reaches into the hundreds of millions. The opportunity for facility owners to improve energy and water performance of their venues, reduce operating costs and engage their communities is enormous. The report looks at the progress already being made in many of the nation’s sports venues; challenges to widespread improvement; and opportunities to move forward.

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Project Team
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Adam Guzzo, U.S. Department of Energy
Jason Hartke, U.S. Department of Energy
Sultan Latif, U.S. Department of Energy
Clark Reed, U.S. Environmental Protection Agency
Sustainable Buildings Industry Council

In 2017, the National Institute of Building Sciences sunset the Sustainable Buildings Industry Council (SBIC). Founded in 1980 as the Passive Solar Industries Council, the independent, non-profit organization that later became the SBIC was a pioneer advocate of the whole building approach to sustainable facilities. Over the decades, the SBIC participated in a number of cutting-edge efforts, including founding of the WBDG Whole Building Design Guide® online portal. The council published several notable guides, among them the High-Performance School Buildings Resource and Strategy Guide; Beyond Green™: Guidelines for High-Performance Homes—Meeting the Demand for Low-Energy, Resource-Efficient Homes; and Procurement of Architectural and Engineering Services for Sustainable Buildings—A Guide for Federal Project Managers.

Over the years, SBIC’s goals have become widely recognized within the industry through programs such as the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) program, the Green Globes certification and the increasing growth in Passive House design and zero-energy buildings. The Institute’s other programs, including the WBDG website, will continue to bring the Beyond Green™ concepts to the broader building industry.

Looking Ahead

The National Institute of Building Sciences will continue to host the annual Beyond Green™ High-Performance Building and Community Awards to support the industry in developing solutions to achieve sustainable, high-performance buildings. This unique awards program recognizes the initiatives that shape, inform and catalyze the high-performance building market, as well as the real-world application of high-performance design and construction practices. The 2017 award winners will receive their awards in January at Building Innovation 2018.

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High Performance Building Council

In 2017, the National Institute of Building Sciences sunset the High Performance Building Council (HPBC). The Institute founded the HPBC in 2007 in response to a request from the U.S. Secretary of Energy to assess the existing voluntary standards and rating systems that defined high-performance buildings at the time. The HPBC delivered the resulting report, Assessment to the U.S. Congress and the U.S. Department of Energy on High Performance Buildings, to the Department of Energy (DOE) in 2008. In the years since, the HPBC worked on the Owners Performance Requirements Tool (OPR) and related report for the U.S. Department of Homeland Security (DHS) Science & Technology Directorate (S&T); the report, A Common Definition for Zero Energy Buildings, Net Zero Building Definition Paper for DOE; and the National Performance Based Design Guide based on research and development supported by DHS S&T and the U.S. General Services Administration (GSA) Public Buildings Service. The HPBC mission has since permeated into virtually all of the Institute’s other councils and committees; high performance is a primary theme of the Institute’s conferences; and the Institute’s Consultative Council prioritizes high-performance buildings in its recommendations to the president of the United States and Congress. The Institute acknowledges the many past and continuing efforts of HPBC members to advance high-performance buildings to the benefit of the country.

Looking Ahead

The Institute will continue to advance the concepts of high-performance buildings in its councils, committees and projects.

Learn More
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VA Facility Management Programs

In 2017, the Institute completed its contract with U.S. Department of Veterans Affairs (VA) Construction and Facilities Management (CFM). This historic preservation reuse initiative included development of a Building Reuse Assessment Tool to evaluate historic buildings for adaptive reuse; investigation of best practices for the reuse of historically significant buildings for healthcare-related services; and prototype designs for VA historic building configurations for clinical, administrative and residential healthcare services. The Institute directed a project team of five subject matter expert firms to synergize their knowledge into a toolkit that will be used cross-platform internally and shared by VA’s Central Offices and local Veterans Integrated Service Networks.

Looking Ahead

In 2018, the Institute will team up with VA CFM staff to present the Building Reuse Assessment Tool and its uses at The American Institute of Architects (AIA) National Convention in New York City in June.

Learn More

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The Commissioning Industry Leaders Council (CxILC) held its annual meeting in January during Building Innovation 2017 and continued to strategize about opportunities to enhance understanding of commissioning. Throughout the year, CxILC members remained active with the Commercial Workforce Credentialing Council and promoted the value of U.S. Department of Energy (DOE) recognized credentials. Several members received recognition of their respective certification programs from the DOE Better Buildings Workforce Guidelines program.

Looking Ahead

In 2018, the CxILC will continue to support broad outreach to building owners and regulators on the value of commissioning. As standards and other guidance continue to develop, the council will look for opportunities to integrate new resources into the relevant pages of the WBDG Whole Building Design Guide® website. Additionally, the CxILC will identify opportunities to engage in the code development process, particularly for the International Energy Conservation Code, which will be updated in 2019.

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The National Mechanical Insulation Committee (NMIC) for Building and Industrial Applications is chaired by the National Insulation Association (NIA), and the NIA’s Foundation for Education, Training and Industry Advancement funds many of its activities. In 2017, The committee continued its work, updating several pages of the Mechanical Insulation Design Guide (MIDG) hosted on the WBDG Whole Building Design Guide® web portal. The NMIC also began planning development of a new insulation calculator.

Looking Ahead

In 2018, the NMIC will continue to update the MIDG, develop the new calculator and provide educational resources on mechanical insulation. The NIA currently is developing a Thermal Insulation Inspector Program that will provide certifications that promote employee and public safety, protect the environment and reduce the economic impact of non-compliance with mechanical insulation specifications and improper and/or untimely maintenance of mechanical insulation systems. The e-learning modules on the MIDG will be a prerequisite to taking the inspector class.

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Committee Leadership
Chair: Ron King, Past President and Consultant, National Insulation Association

Architectural Computer Services Inc. (ARCOM - Masterspec)
ASHRAE
Midwest Insulation Contractors Association (MICA)
National Insulation Association
North American Insulation Manufacturers Association
Oak Ridge National Laboratory
U.S. Army Corps of Engineers
U.S. Department of Energy
U.S. Department of Veterans Affairs
U.S. General Services Administration
U.S. Naval Facilities Engineering Command
INFORMATION RESOURCES & TECHNOLOGIES
Building Research Information Knowledgebase

The Building Research Information Knowledgebase (BRIK), a joint project of the National Institute of Building Sciences (NIBS) and The American Institute of Architects (AIA), made 2017 the “Year of Marketing” for BRIK, doubling the AIA’s efforts to increase its members’ awareness and use of the online research portal through dedicated print and digital advertising. This effort served as part of a larger campaign designed to make AIA members aware of the value of research to their practices, and to extend this effort further, NIBS staff took part in an AIA-sponsored Research Summit in St. Louis in July. BRIK also acquired new partners in 2017 and extended its database for the purpose of offering a wider variety of professionally reviewed building-related research. Additionally, NIBS and AIA jointly hosted booths at Building Innovation 2017 Conference in Washington, D.C., and at the AIA National Convention in Atlanta to showcase BRIK and demonstrate its use.

Looking Ahead

2018 will see a new council structure and a rededicated effort to encourage more partners to share their knowledge via the BRIK website. The staffs of NIBS and AIA will once again join forces to promote BRIK at Building Innovation 2017 in Washington, D.C., and the AIA National Convention in New York City.

National Clearinghouse for Educational Facilities

The National Clearinghouse for Educational Facilities (NCEF) website, at www.ncef.org, continued as an archival site in 2017 due to lack of funding. Despite its archival status and waning use, NCEF remained a primary resource of information on constructing and maintaining educational facilities. More than 43,200 visitors visited the site in 2017, viewing 113,030 pages over the course of the year.

Looking Ahead

In 2018, the material housed on the NCEF website will be evaluated for inclusion in other Institute venues.

Learn More

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The WBDG Whole Building Design Guide® reached its 20th anniversary of operation in 2017, with 5 million visitors to the site viewing 14,382,656 pages during the course of the year. Subject matter expert committees updated three major sections of the WBDG during 2017. Five new resource pages and several new case studies also joined the mix, utilizing to great effect WBDG's new format, launched in late 2016. WBDG now offers more than 100 online WBDG and Federal Energy Management Program (FEMP) courses. Institute staff members worked to promote the use of WBDG through presentations to multiple audiences, including the National Facilities Management and Technology Conference (NFMT); American Institute of Architects (AIA) Washington, D.C. Chapter; and the U.S. Department of Commerce Special American Business Internship Training (SABIT) program. The WBDG served as the subject for regular articles in the Institute's monthly newsletter, Building Sciences, and in the Institute's magazine, Journal of the National Institute of Building Sciences (JNIBS).

Looking Ahead

In 2018, WBDG will continue to add new case studies and resource pages, as well as new FEMP online courses. In addition, the Building Envelope Design Guide (BEDG) portion of the website will receive a major refresh. Staff will continue to promote WBDG via live presentations at meetings and conferences, including NFMT in Baltimore, and the AIA National Conference in New York City, as well as via Twitter, LinkedIn and other social media, blogs and podcasts.

GSA Central Facility Data Architecture and Taxonomy

In 2017, the National Institute of Building Sciences worked with the U.S. General Services Administration (GSA) Public Buildings Service (PBS) Office of Public Buildings Information Technology Services (PB-ITS) to identify GSA requirements for comparing building energy performance as modeled with actual measured energy performance. Working with GSA staff, the Institute also initiated revisions to the GSA Spatial Program Validation specification to create a comprehensive Industry Foundation Class (IFC)-based model view definition (MVD) to identify exchange requirements between building information modeling (BIM) applications and GSA systems for planning, design, construction and operations of its facilities.

Looking Ahead

In 2018, the Institute and GSA staff will complete the comprehensive GSA information exchange specification. The Institute team will work with GSA, its design consultants and software and system providers to deploy the exchange specifications to allow GSA to further integrate data from BIM with its internal systems to improve facility operations.
In 2017, the buildingSMART alliance® Board of Direction worked to align the activities of the Alliance subcommittees with overall council goals. The board worked on an operations plan to re-focus the initiatives of its subcommittees around a single target: the update and delivery of its flagship national computer-aided design (CAD) and building information modeling (BIM) standards – the United States National CAD Standard® (NCS) and National BIM Standard–United States® (NBIMS-US™).

Looking Ahead

The Alliance scheduled a workshop early in 2018 to begin planning for the evolution of the NCS and NBIMS-US™.

National BIM Standard-United States®

Since the buildingSMART alliance® released the latest edition of the nation’s building information modeling (BIM) standard in 2015, more than 42,500 users in 140 countries have downloaded the National BIM Standard–United States® (NBIMS-US™) Version 3 (V3). Countries leading the way include the United States, China, the United Kingdom, Canada and Germany. In 2017, the Alliance began initial discussions to plan prioritizing the BIM standards work.
United States National CAD Standard®

In 2017, the Steering Committee for the nation’s computer-aided design (CAD) standard focused on education and training to support the continued adoption and implementation of the United States National CAD Standard® (NCS) Version 6. Building on its 2016 webinar series, the Steering Committee developed two new one-hour educational webinars. The first explained what a layer is, why layers are needed and how to name and implement them. The second webinar addressed building information modeling (BIM) implementation.

Looking Ahead

In 2018, the buildingSMART alliance®, which oversees development of the NCS, will begin the process of updating the standard. The next development cycle is expected to begin in the fall of 2018.

National BIM Guide for Owners

The National Institute of Building Sciences debuted its new building information modeling (BIM) guide, the National BIM Guide for Owners (NBGO), at Building Innovation 2017 in January. While there, the multidisciplinary team of experts from various stakeholder groups that developed the NBGO on a fast-track schedule received the Institute’s 2016 Honor Award at the Institute’s 2017 Annual Banquet. The Guide, which was downloaded 2,200 times in its first year of existence, was developed to help building owners and their design teams use BIM during a facility’s planning, design, construction and operations processes and to better support owners’ performance requirements. Created under the auspices of the Institute, Building Owners and Managers Association International (BOMA) and ASHRAE, the NBGO provides information in three major areas: process; infrastructure and standards; and the Project Execution Plan.

Looking Ahead

In 2018, the Institute will serve on ASHRAE Special Projects Committee SPC 224, Standard for the Application of Building Information Modeling, to develop the NBGO into an industry standard.
Facility Maintenance and Operations Committee

The Facility Maintenance and Operations Committee (FMOC) hosted its annual meeting in January during Building Innovation 2017 in Washington, D.C., and met again in March at the National Facilities Management and Technology Conference & Exposition (NFMT) in Baltimore. In July, the committee convened at the Institute’s office for a strategic planning session to update its mission and objectives. The FMOC’s updated objectives are to increase consideration of operations and maintenance issues during the facility acquisition process; promote the sharing and integration of facility operations and maintenance procedures and information; and identify and disseminate “best practices” for facility operations and maintenance. Throughout the year, the committee worked on two resource papers and cooperated with the WBDG Whole Building Design Guide® Advisory Committee to update the Facilities Operations & Maintenance section of the WBDG website.

Information Exchanges

In 2017, the Construction-to-Operation Building information exchange (COBie) Task Group (CTG), the group within the buildingSMART alliance® (bSa) that oversees development of the COBie standard, convened in March to review, discuss and consider industry proposals to amend the latest edition. COBie is part of the nation’s building information modeling (BIM) standard, the National BIM Standard-United States® (NBIMS-US™). Members of the CTG also worked to promote and support wider adoption of COBie.

Looking Ahead

In 2018, the CTG plans to submit the team-approved COBie revisions to the NBIMS-US™ when the next standard development cycle begins.

Learn More

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CTG Leadership

Chair: Michael Tardif, Building Informatics
Vice Chair: Brian Haines, FM:Systems
Secretary: TJ Meehan, CADD Microsystems

Looking Ahead

The FMOC will convene in January at Building Innovation 2018, and in March at NFMT 2018. The committee will release finalized resource papers on maintainability and facility transitioning. The FMOC also is planning to develop more resource papers for the WBDG and several online training sessions.

Learn More

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Committee Leadership

Chair: Darrell Rounds, FMA, CEM, General Motors Company
Institute Board Liaison: Thomas L. Mitchell, Jr., USAF, CFM, CFMj, IFMA Fellow, FM3IS Associates, LLC
ProjNet™ helps owners manage each step in a facility design review and acquisition process to foster authorized stakeholders’ collaboration and improve overall design and construction project management. In 2017, the National Institute of Building Sciences continued to manage this secure, integrated, internet-based suite of design and construction tools, providing ProjNet™ sales support and overseeing hardware, software, networking, information assurance, programming and customer support activities. During the year, the ProjNet™ team worked on the modernization of the ProjNet™ suite and the U.S. Department of Defense (DOD) and the U.S. Department of State (DOS) Assessment and Accreditation (A&A) of the ProjNet™ system. ProjNet™ received a 3-year Authority to Operate (ATO) through March of 2020 from DOD.

Looking Ahead

In 2018, DrChecks™, the flagship application of the ProjNet™ suite of project development tools, will celebrate its 20th anniversary. In addition, the ProjNet™ team will beta test the implementation of the new interface for the ProjNet-DrChecks™ application.

FHWA Building Information Modeling for Bridges Demonstration

In 2017, the National Institute of Building Sciences and WSP, Inc. worked with the Federal Highway Administration (FHWA) to implement the agency’s recommendations from its 2016 Advancement of Bridge Information Modeling (BrIM) Standards Report. The project team evaluated and recommended contract language for model-based deliverables. The team also initiated development of an extension to the American Association of State Highway Transportation Officials (AASHTO) bridge design software, AASHTOWare, to generate Industry Foundation Class (IFC) data.

Looking Ahead

The project team will continue its FHWA work in 2018, completing the AASHTOWare-IFC integration and supporting bridge modeling demonstration projects for the Utah Department of Transportation aimed at advancing the use of open standards-based bridge models in the United States. During the year, the AASHTO Subcommittee on Bridges and Structures (SCBS) Technical Committee on Technology and Software (T-19) will be initiating a pooled fund project to continue to develop and deploy BIM for design and construction of bridges. The Institute anticipates a role in the pooled fund project to continue to advance the use of open standards for bridge models.
buildingSMART International Product Room and buildingSMART Data Dictionary Management

Nациональная Академия строительных наук сотрудничала в 2017 году в качестве лидера в проекте buildingSMART International (bSI) Product Room и помогала в работе над библиотекой данных buildingSMART Data Dictionary (bSDD). Европейские и азиатские страны с национальными программами расширили свое участие в Product Room, а общие объектные библиотеки продолжают расти, чтобы поддерживать моделирование информации о зданиях (BIM) и управления проектами вокруг мира. Сотрудники завершили интеграцию bSI Industry Foundation Class (IFC) модели и bSDD для поддержки связей между IFC и широким диапазоном инфраструктурной информации. Для дальнейшей поддержки интеграции с одним из таких источников информации, продолжается работа над разработкой совместимого фреймворка и процесса для шаблонов продукта, который интегрирует IFC и Model View Definition (MVD) стандарты, в ответ на требования пользователей к открытому, стандартизированному подходу, который соединяет продуктную информацию с информационными моделями.

Looking Ahead

Структура bSI Product Room и bSDD будет поддерживаться Институтом в 2018 году, когда bSI внедрит процедуры для согласования терминологии, используемой в моделях с применением и программами вокруг мира.

U.S. Department of State Overseas Building Operations BIM Program Development

In 2017, the National Institute of Building Sciences completed a building information modeling (BIM) and management roadmap for the U.S. Department of State (DOS) Overseas Building Operations (OBO) to support the office’s goals to improve the use of building information in its overseas building design, construction and facilities program. The roadmap covers integration of BIM with OBO systems and processes, and provides recommendations on guidelines and contract language for aligning design and construction projects with BIM program goals. With the roadmap in place, the Institute’s project team began helping OBO implement recommendations to optimize the use of BIM data and create integrated workflows with information systems to improve the quality and consistency of project data for use internally and by OBO design consultants. In addition to data management support, the team worked with OBO to make revisions to OBO BIM standards, requirements and guidelines to align what consultants provide with OBO BIM uses for space planning, model authoring, design review, record modeling and asset management.

Looking Ahead

In 2018, the Institute will continue to develop the roadmap to cover additional BIM uses, and support the implementation of recommendations with a focus on space planning, model authoring, design review, record modeling and asset management.
Building Innovation 2017—The National Institute of Building Sciences Fifth Annual Conference and Expo—brought together hundreds of building industry professionals to concentrate on Collaborating for a High-Performing Future. Held January 9-12, 2017, at the Mandarin Oriental in Washington, D.C., the event included four enriching days of quality programming and activities; 45 presenters in 16 educational sessions offering 24.5 continuing education units; four social networking events; two inspiring award ceremonies; the latest in technologies from 18 exhibitors; one book signing and a virtual trip to Mars City.

During meetings on Monday, the Board discussed normal business activities and voted on a number of issues and the Consultative Council released its 2016 report, Moving Forward. Members participated in a presentation hosted by the Science, Technology, Engineering and Mathematics (STEM) Education Program to explore a unique path forward to developing the future generation. The session featured a demonstration of the Mars City Facility Operations Challenge created by the Institute, Total Learning Research Institute (TLRI) and the National Aeronautics and Space Administration (NASA) to introduce high school students to facility management by teaching them to operate a virtual base on the planet Mars and to inspire them to consider one of the many careers in the building sciences.

On Tuesday, Judson J. McIntire, AIA, NCARB, LEED AP, Smithsonian’s Program Executive for the newly opened National Museum of African American History and Culture on the National Mall, delivered the Opening Keynote Breakfast. He gave an uplifting presentation about the collaborative effort the Smithsonian undertook with the design team, city officials, federal agencies and citizens across the country to complete this historic and long-awaited project. Following the breakfast, Institute President Henry L. Green, Hon. AIA, unveiled the National BIM Guide for Owners. Attendees took part in the two morning educational sessions on collaborating as a team and designing for resilience, then headed to the Exhibit Hall Walking Lunch, where they had a chance to learn about the latest technologies and opportunities in the building industry. People who stopped by the Mars City booth were able to take a virtual tour of the Mars City Facility Ops Challenge, navigating the building information model (BIM) of the futuristic Mars City base developed by KieranTimberlake, Gilbane Building Company and Alderson Engineering. After the four afternoon sessions on BIM, research, industrialization and preparing the workforce, everyone headed back to the Exhibit Hall for the Exhibitor Reception to network and discuss the day’s events.

Wednesday was a whirlwind of activity. Most of the Institute’s councils and committees convened for their annual meetings. The WBDG Whole Building Design Guide® launched its redesigned web portal and National Council of Governments on Building Codes and Standards released a white paper on the role of existing building codes.

Five educational sessions were held throughout the day covering a range of topics, from designing for occupant needs to lifecycle planning. Plenary Luncheon Keynote, Jonathan F.P. Rose, President of Jonathan Rose Companies LLC and author of The Well-Tempered City: What Modern Science, Ancient Civilizations and Human Behavior Teach Us about the Future of Urban Life, spoke about the role cities have played throughout history. “The world is rapidly urbanizing,” Rose explained, as he talked about how the population is shifting to cities and how housing, water, waste removal, transportation and other systems are needed to support this rapid influx. That evening, the Institute hosted its Annual Reception and Awards Banquet where the Institute recognized new and retiring Board members, and honored the 2016 award winners.

On Thursday, FEDCon® Breakfast Keynote Shawn Norton, Branch Chief for Sustainable Operations and Climate Change at the National Park Service, celebrated the history of the agency and the importance of building for resilience and stewardship so the “Parkitecture” of the National Parks can last for generations. “Our goal is operational continuity,” he said, explaining how many of the nation’s coastal treasures are increasingly vulnerable, and giving an example of the Cape Hatteras (N.C.) Lighthouse, which was moved at a cost of $15 million dollars. “Resilience is important,” he said, “But it really is going to be, for us, adaptive management.” The morning sessions focused on creating resilient communities and utilizing information technology for better building performance. At the Beyond Green™ Awards Lunch, the Sustainable Buildings Industry Council recognized the 2016 awards winners, who then discussed their projects and received their awards. Following the lunch, attendees selected from the final four sessions of the week.

In the completed follow-up survey, Conference attendees gave Building Innovation 2017 an overall rating of 8.125 out of 10 points and provided positive feedback on the quality of programs and presenters.
Introduction

The National Institute of Building Sciences Consultative Council serves a unique role in the building industry. It brings together representatives from leading organizations that represent all aspects of design, construction, operation and regulation to examine important issues before the industry and provide findings and recommendations to the President of the United States and the U.S. Congress on how to effectively address them. In 2017, members of the Consultative Council decided to focus on the future. They wanted to explore how the building industry can and should evolve to meet the changing needs of society and how new technologies and practices can attract a 21st century workforce.
Building the Industry of the Future

Over time, the sectors that drive the economy, the needs and desires of citizens and the metrics of progress change. Buildings and infrastructure serve as important resources that enable such progress to occur. Despite the slow progress the building industry has made implementing internal changes in the past, it continues to provide businesses and communities with the facilities necessary to achieve their missions, and individuals with housing that is comfortable, safe and efficient. However, one question arises as the pace of technology and commerce accelerates and communities face new challenges of resilience and sustainability: Will the building industry be ready?

Populations in the United States (and around the world) continue to move to and expand in urban centers. Whether located along the coasts or other waterways, or in areas prone to drought or earthquakes, many such cities are particularly vulnerable to disasters. To avoid social, economic and environmental disruption, buildings and infrastructure in at-risk locations must be resilient and will require necessary investment.

At the same time, resources to support the design, construction and operations of buildings, including energy, water and materials, could become increasingly constrained and expensive, advancing the need for sustainable approaches.

The fragmented nature of the building industry, which brings together different groups of small businesses with each project, has resulted in inefficiencies and a slow rate of technology adoption. Technological advances, both from outside and within the industry, present significant opportunities to advance productivity and increase efficiency. Yet, the industry must be primed to swiftly incorporate such technology—which has not been a priority in the past.

Meanwhile, today’s building industry workforce is aging and there is a growing concern that new entrants are not attracted to this market segment. Moving the building industry forward, as discussed in this report, could serve as a catalyst to excite and engage the next generation of building-related workers.

Innovative building owners, designers, contractors, manufacturers, scientists, technology companies and communities already are leading the way in demonstrating how buildings and infrastructure should be designed, constructed, operated and regulated. To help move the industry ahead, their lessons learned and benefits achieved must be documented, shared and replicated.

The building industry needs a holistic examination with targeted investment of resources—including personnel, intellectual and financial capital—to meet the growing demand for high-performance buildings. Such an approach must look at all factors that influence the building process—research, development and deployment (RD&D); technology; workforce; procurement; codes and standards; professional, technical and vocational training; design fees, schedules, processes and contracting; performance goals; and building occupants. This report examines some of those key drivers of progress, outlining the challenges and opportunities for moving forward.

Design, Construction and Operations

The building industry saw significant advances in the latter half of the 20th century, with an increased focus on life safety through building codes and other guidance; the development and deployment of tools such as computer assisted/aided design (CAD) and building information modeling (BIM) to support increasingly efficient design and construction processes; sustainability through green building rating programs; and building science knowledge around building enclosures, indoor environmental quality and energy and water efficiency. However, the design, construction and operations processes remained focused on optimization within disciplines and components—and the processes, contracts, codes and standards and training to support such an approach.

In the 21st century, the industry is recognizing the need to evolve to meet the new challenges and demands placed on buildings, infrastructure and cities. However, the design, construction and operations processes require a shift in training, contracts, codes and standards to align with integrated teams that are collaboratively co-creating to address a multiplicity of performance-based criteria.

Project Delivery

Historically, the project delivery contracting structure primarily governed the relationship between the multiple disciplines involved in the project and their attitude towards the project. In recent years, the contract structures have begun to evolve to meet current needs. Previously, contract types focused on the phases of construction—design, bid, build—and payment terms, including lump sum, cost plus fixed fee and cost plus percentage of cost. Such approaches may still have their place in the industry, but they perpetuate the disjointed processes that hinder collaboration in achieving a high-performance building.

Contracts today include a variety of project delivery methods, including: design-negotiate-build, construction management (CM), CM as owner’s agent, CM at risk, design-build, integrated project delivery and design-build-operate-maintain. These alternative project delivery methods are the industry’s response to improve outcomes associated with traditional 20th century approaches. The resulting procurement reform to accommodate these changes is slow, but underway.

Allocation of Design Fees

In addition to new contract structures, the industry also must examine whether the existing allocation of design and construction fees offers the greatest value for the owner and aligns with project priorities and the steps that add to that value. As discussed in this report, BIM provides building owners and operators with information that facilitates efficient operations across the entire life cycle of the facility. Building owners should work with members of the architecture-engineering-construction (AEC) team to identify the information that should be included in the BIM and then compensate the AEC team appropriately for the additional value provided.1

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1 The National BIM Guide for Owners helps building owners develop and adopt a documented process and procedure for their design team to follow in order to produce a standard set of BIM documents during the design and construction of the facility, and for maintenance and operations of the facility upon handoff. [https://www.nibs.org/nbgo](https://www.nibs.org/nbgo)
Building teams may also wish to examine how members from the design and construction stages can stay involved with the project into the operations stage, which will help owners better realize their long-term project performance goals and provide valuable feedback loops that lead to improved future projects. One example of a successful foray into bridging the gap between design and construction and building operations was the General Services Administration’s performance-based approach used for the design and construction of the Federal Center South building in Seattle, Washington.2

Policies, Codes and Standards

The United States has gained worldwide respect for its inclusive and transparent codes and standards development processes, levels of protection and commitment to enforcement. Yet these processes are perceived as slow to keep pace with technological advances. This perception arises not because the code development process is slow, but largely because many states and local jurisdictions do not have a systematic process in place to regularly adopt newly revised codes. Codes and standards too must evolve to help meet the changing needs of the industry. Jurisdictions need to have codes and standards development and adoption on a schedule that recognizes the increased pace of development of new materials, products and methods and the expanding need for resilient and resource-efficient communities. This includes assuring that legislators and other decision makers are informed on why codes and standards are regularly updated. While adoptions occur primarily at the state and local level, the federal government has an increasing interest in assuring such processes occur in a timely manner; out-of-date codes can lead to increased federal costs in disaster recovery, and national energy and water efficiency are served by the provisions incorporated in energy and plumbing codes. The federal government should identify potential mechanisms to incentivize adoption of up-to-date building codes. Such incentives need not be monetary—enforcing current codes can be among the eligibility requirements for relevant grant programs or part of the calculation for disaster recovery funding.

To help meet project- and community-level goals, codes and standards developers (with the engagement of community representatives) should develop criteria to support increased focus on building performance and outcomes rather than prescriptive measures. Performance measures should be formulated with an eye towards ongoing improvements to encourage development of innovative materials, methods, tools and technologies. Policy-makers should coordinate policies to address building performance not just during the design and construction process, but throughout the building’s life cycle.

Two emerging opportunities support the evolution of codes to meet current needs. The code official should be recognized as a valuable member of the building team, serving in the role of advisor rather than adversary. Codes and standards developers should identify mechanisms to assure that buildings can remain functional post-disaster in support of economic and social resilience, and not just the short-term protection of life safety.3

Off-Site Construction

Recognizing the increased focus on worker shortages, project quality, speed to market, job-site safety and sustainability, owners and their design teams are increasingly looking at off-site construction as an option to help meet their needs.4 To realize the potential benefits of off-site construction, the project team should examine its potential utilization early in the design process and deploy it as part of an integrated design and construction process. This requires a shift in thinking by architects, engineers, contractors, code officials and the education and training providers for these disciplines.

Shifting the Industry

Due to the size and fragmentation of the building industry, reform is slow. Per the World Economic Forum, “The United States has 710,000 [engineering and construction] companies; only 2% of them have more than 100 workers and 80% have 10 workers or fewer.”5 Because the industry lacks a major industry player with enough market share or influence to initiate the shift, no single company nor small group of companies are in an overly strong or influential position in the industry. Therefore, government, as a major client, can and must drive the shifts needed.

Technology

Meanwhile, the development and deployment of new and enhanced technologies, whether specifically for use by the building industry or in general, has grown significantly. The traditional building industry must be prepared to adopt and utilize such advancements or entities from outside the industry will realize, and then fill, the opportunities to improve current processes. Codes, standards and other guidance must evolve to provide meaningful direction in this increasingly digital environment.

BIM and Data

BIM is moving beyond merely a design and construction tool; an increasing number of disciplines, including facility managers, code officials, emergency managers and first responders, are facilitating the widespread and efficient use of building-related information across the building life cycle. Building- and occupant-related data from an increasing network of sensors and controls are further feeding the ability to operate facilities efficiently and inform the design and construction of new or the renovation of existing facilities. Representatives from across the industry should work collaboratively to identify and implement common metrics and support the interoperability of data to further improve facilities and the industry.

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2 See a case study on Federal Center South on the WBDG Whole Building Design Guide® at wbdg.org/additional-resources/case-studies/federal-center-south-building-1202.

3 NIST has been directed by Congress to support development of an “Immediate Occupancy Code” to address post-earthquake building occupancy. Such an approach should be considered for other hazards as well.

4 Off-site construction is defined as “the planning, design, fabrication and assembly of building elements at a location other than their final installed location to support the rapid and efficient construction of a permanent structure. Such building elements may be prefabricated at a different location and transported to the site or prefabricated on the construction site and then transported to their final location. Off-site construction is characterized by an integrated planning and supply chain optimization strategy.” Off-Site Construction Council, Glossary of Off-Site Construction Terms. www.nbs.org/resource/nmsp/OSCC/GlossaryOfSiteConstructionT.pdf


Sensors, Controls and the Internet of Things

The growing interest in data-supported decision making and the potential to support efficient operations through increased automation are both driving expansion in sensors, controls and the Internet of Things (IoT). While these advancements provide significant opportunities to advance building performance, the data they provide and the activities they can facilitate can quickly overwhelm the industry. The changing design, construction and operations processes, coupled with advancements in building-related technologies, make this an exciting time to enter the building industry, particularly when the availability of a future workforce is such a big industry concern. The concerns encompass two main areas: workforce shortages (the lack of workers available to do jobs in the industry) and the workforce skills gap (where employers in large parts of the industry struggle to find workers who are keeping up with technology and code advances). According to the U.S. Bureau of Labor Statistics, the construction industry lost about 40% of its workforce—around 2.3 million workers—between April 2006 and January 2011. Approximately 6 in 10 of those workers left the industry altogether by 2013.\textsuperscript{12} This

In addition to its use in building operations, IoT serves the construction industry through equipment and employee tracking devices, such as wearables, drone surveying and other information collected on the job site. As companies continue to implement cost-saving measures and increase efficiencies, they are turning to IoT to improve site operations. Wearable devices also have the ability to track workers in the field and monitor for job-site hazards and whether equipment is in need of repair.

Cybersecurity

Strategic Risk Advisor Troy Carlson wrote in *Construction Business Owner*, “With the growing use of digital technology, the construction industry is more vulnerable than ever to cybersecurity threats. With the amount of work now completed online and on computers or tablets—from BIM to invoices, building automation services and everyday correspondence about projects—construction companies are opened up to innumerable cybersecurity threats and liability. If a company is not adequately protected against exposure, the associated costs can be financially crippling.”\textsuperscript{6}

These vulnerabilities are not just on the construction job site; they exist throughout the life of the building. As building systems and components become increasingly connected through building automation systems and IoT, they become vulnerable to attack.\textsuperscript{7} Policies, procedures, tools and training must be in place to assure that this risk is addressed.

Virtual and Augmented Reality, Drones and Additive Manufacturing

Virtual and augmented reality technology are emerging as tools to support collaboration among stakeholders and allow construction teams to detect errors ahead of time and avoid unnecessary project costs. This technology could also improve job-site safety and allow construction teams to view job-site conditions without subjecting them to safety hazards.\textsuperscript{8} As identified by the Institute's Science, Technology, Engineering and Mathematics (STEM) Education Program, integrating BIM and virtual reality, along with simulated scenarios or decisions, can provide building owners, facility managers, code officials, first responders and others with a valuable decision support tool before any construction is undertaken.\textsuperscript{9}

Additive manufacturing (commonly called 3D printing) is changing the way structures are being built by allowing construction teams to “print” structures at high speeds with precision. Project teams also are using this technology to print the complex structures and objects that make up buildings. Creating these complex objects by hand and at scale is a massive undertaking, but with 3D printing the task becomes much more efficient.

Firms are increasingly using drones to monitor site conditions, document the construction progress and even inspect hard-to-reach building features. For example, insurance companies deployed drones to help conduct preliminary damage assessments following Hurricane Harvey.\textsuperscript{10}

Robotics and Human Augmentation

In addition to their use in “printing” buildings, robots are being deployed to undertake repetitive processes within the industry, such as bricklaying. In the future, robots could be utilized to support manufacture and placement of off-site building components. Autonomous construction equipment and delivery vehicles will change the job site.

Wearable technology advances also hold promise in creating new jobs in the industry since specialized workers will be needed to manage the technology itself, while at the same time providing new and innovative ways for industry workers to increase their productivity and enhance worksite safety.

Exoskeleton technology, for example, which has been increasingly used in healthcare and military applications, is now making its way into the construction industry. As competition in this market space increases and costs even out, this type of technology—and others yet to be developed—have the potential to increase the skills, scope and training needs of workers entering the industry.\textsuperscript{11} Privacy concerns and the appropriate use of data will need to be addressed as the use of these technologies grow.

Workforce

The changing design, construction and operations processes, coupled with advancements in building-related technologies, make this an exciting time to enter the building industry, particularly when the availability of a future workforce is such a big industry concern. The concerns encompass two main areas: workforce shortages (the lack of workers available to do jobs in the industry) and the workforce skills gap (where employers in large parts of the industry struggle to find workers who are keeping up with technology and code advances).

According to the U.S. Bureau of Labor Statistics, the construction industry lost about 40% of its workforce—around 2.3 million workers—between April 2006 and January 2011. Approximately 6 in 10 of those workers left the industry altogether by 2013.\textsuperscript{12} This

\begin{itemize}
\item \textsuperscript{7} Further information on building industry-related cyber risks are covered in the WBDG Whole Building Design Guide®, wbdg.org/resources/cybersecurity.
\item \textsuperscript{8} www.constructiondive.com/news/construction-industry-trends-2017/433151/
\item \textsuperscript{9} See “Advancing Future Technology while Inspiring the Next Generation.” www.nibs.org/resource/resmgr/STEM_PROGRAM.pdf.
\item \textsuperscript{11} www.fastcompany.com/3049042/this-industrial-exoskeleton-helps-workers-carry-their-loads
\item \textsuperscript{12} https://www.bls.gov/opub/mlr/2011/04/art4full.pdf
\end{itemize}
challenge, coupled with the general aging of the U.S. workforce and fewer workers entering the industry, means that the industry is struggling to fill the estimated 500,000 construction jobs that are currently open—as well as the thousands more that will need to be filled in the future. The continual decline in access to trades-related training in high schools, the lack of awareness of fulfilling and successful careers in the building trades and the society-wide definition of success focused on pursuing a four-year degree have exacerbated these challenges.

Today’s building industry workforce requires unprecedented technological, social, cultural, political and economic savvy, and the industry is evolving to address its workforce challenges in a number of ways. Across many parts of the industry, there is strong upward pressure on wages, as employers and developers seek out qualified workers. In addition, more industry employers are actively partnering with labor unions, trade associations, local workforce boards and community colleges to develop and promote trades training programs and specialized coursework in advanced design and construction techniques.

Enticing more young U.S. workers into jobs in the industry, and reaching out to “non-traditional” workforce categories, including women and veterans, are the key elements in addressing the current shortage. Reaching younger workers will take a significant effort. As identified by Nicholas Wyman, CEO of the Institute for Workplace Skills and Innovation, “Just a few decades ago, our public education system provided ample opportunities for young people to learn about careers in manufacturing and other vocational trades. Yet, today, high-school students hear barely a whisper about the many doors that the vocational education path can open. The ‘college-for-everyone’ mentality has pushed awareness of other possible career paths to the margins.”

Women continue to be vastly underrepresented in the construction workforce, yet they remain a significant potential source to address worker shortages. Women currently comprise almost half of all U.S. workers, yet account for only 2.6% of workers in the construction industry.

Training programs that provide mentors for women, and access to a broad range of industry trades, are needed in order to address this potential workforce. Likewise, as veterans look to transition into sustainable and successful careers in the private sector, more organizations and employers are looking to train U.S. veterans for jobs in the building industry. “Helms to Hard Hats” programs are successfully training returning veterans to enter careers in the building industry and should be expanded. Because of the persistent nature of worker shortages, the building industry is beginning to look at viable workarounds to maintain or increase productivity. Already, off-site construction and prefabrication techniques are helping the industry to streamline the construction process with fewer workers. While significant traditional automation in the industry will take years to develop, many companies are looking to invest in technologies and concepts that hold promise for increasing automation as an option to help them deal with the lack of available workers.

Research

To continually improve, the building industry must focus on research and development (R&D). Unfortunately, because of the disciplinary-focused nature of the industry and the small size of most companies, there has been limited investment in R&D aimed at moving the entire industry forward. Across all segments of the economy, the United States was the largest R&D-performing country in 2013, with total expenditures of $456.1 billion, a 27% share of the global total, and an R&D/GDP ratio of 2.7%. Yet, information on the actual amount of investment in building-related R&D is scarce. A 2014 book from the International Council for Research and Innovation in Building and Construction estimated U.S. investments at 0.25 percent of the value of construction put in place. A 1994 study by the Civil Engineering Research Foundation put the value at 0.5 percent.

Many governments around the world, recognizing the invaluable role the built environment plays in their economy and the opportunity to support all segments of the economy through improved buildings and infrastructure, have established building industry R&D programs for their countries. Without a commensurate level of investment, the United States risks falling behind other nations—not just in buildings but across the economy.

While discipline-centered programs like architecture, construction management and engineering are commonplace in the United States, college and university programs focused on building science are almost nonexistent. As a result, it is not always easy to find qualified or interested researchers to perform cross-discipline, systems-focused research. In addition, though there has been a rapid increase in new technologies, there is little research available that addresses the performance, reliability and efficiency of new products, systems and processes. For example, codes require the use of air barriers to prevent air leakage from buildings to conserve energy consumption. However, in some cases unintended consequences result because designers lack an understanding of how air barriers function.

With building codes becoming more complex, jurisdictions implementing new energy conservation measures and weather-related risks changing, the United States needs to invest in research to study the performance of systems that incorporate new technologies. A national effort is needed to coordinate and promote collaboration, prevent duplicated research, utilize economies of scale and provide funding.

1www.constructormagazine.com/the-workforce-shortage-report/#WaQbJSiGOM8
8Building 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.
There is a need to collect data within buildings to gauge building performance. Public/private partnerships can be utilized to provide opportunities to lead innovation and partner in research. As discussed above, new technologies could be used to assist with building code enforcement, understanding code requirements and inspection efficiencies. Increased research focused on buildings as a system rather than a collection of individual components will facilitate further advancements in building codes.

**Recommendations**

- The U.S. Congress should ask the Government Accountability Office (GAO) to conduct a thorough review of the current contracting processes it uses to procure federal facilities, and identify opportunities to implement alternative contracting mechanisms and current barriers to the utilization of such approaches.

- The U.S. Congress should require all federally funded construction projects to adopt and effectively enforce building codes that meet or exceed the latest building codes, including projects provided with federal dollars; all states and localities that receive funding associated with community development, infrastructure, public safety or community governance; and all buildings that house federal employees (whether leased or owned).

- The White House should establish a cross-agency program among the U.S. Department of Homeland Security (DHS) Federal Emergency Management Agency (FEMA), U.S. Department of Housing and Urban Development (HUD), National Institute of Standards and Technology (NIST) and U.S. Department of Energy (DOE) that focuses on providing scientific and economic data associated with the effectiveness of building codes and their impacts on communities; education and training for code professionals; technical assistance; and evaluation tools for code department effectiveness.

- Congress, working with FEMA and other federal agencies, should enact incentives for state and local jurisdictions to adopt current codes in order to make communities more resilient in the face of natural disasters and to reduce the cost of federal disaster cleanup and recovery.

- Industry stakeholders should work to incorporate system-level requirements and operations-focused criteria into baseline codes and other policies to assure long-term performance and focus on diligent design, construction and operations in support of community goals and protection of subsequent owners of projects constructed for short-term investors.

- The building industry, with involvement of representatives from the legal, finance and insurance sectors, should conduct a dialogue on how to evolve the current state of fees, timelines and risk in furtherance of a systems-based approach to realize actual, measured performance results.

- DOE, NIST, the U.S. Department of Transportation and other federal agencies should continue working with the building industry to develop an IoT framework that supports efficient deployment of sensors, controls and IoT-enabled devices in facilities and the achievement of building-, community- and national-level goals.

- The codes and standards development community, including the American National Standards Institute (ANSI) and NIST, should work collaboratively to develop protocols and best practices that support the utilization of current and future standards within digital environments, including BIM, additive manufacturing, building automation and robotics.

- Congress, the U.S. Department of Education, U.S. Department of Labor, state and local governments and industry stakeholders should promote technical and trade programs in K-12 and technical schools, emphasizing a good career awaits, not a societal judgment. This is applicable to all students, all genders, all races, all economic backgrounds, to break down preconceived notions of who can choose to go into technical building careers. Specific attention should be directed to training programs that provide mentors for women, and access to a broad range of industry trades.

- The building industry, along with federal agencies, should develop and fund a national high-performance building R&D strategy that reflects the value of the industry to the U.S. economy, mirroring the 2.7 percent economy-wide investment in R&D.
# 2017 Financial Statements

## Statements of Financial Position

<table>
<thead>
<tr>
<th>September 30</th>
<th>2017</th>
<th>2016</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSETS</strong></td>
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</tr>
<tr>
<td>CURRENT ASSETS</td>
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<tr>
<td>Cash and Cash Equivalents</td>
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<td>Accounts Receivable</td>
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<td>Prepaid Expenses and Deposits</td>
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<td>Total Current Assets</td>
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<td>INVESTMENTS</td>
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<td>PROPERTY AND EQUIPMENT</td>
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<tr>
<td>Furniture and Equipment</td>
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<td>557,602</td>
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<tr>
<td>Leasehold Improvements</td>
<td>745,251</td>
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<tr>
<td>Less Accumulated Depreciation and Amortization</td>
<td>(482,350)</td>
<td>(453,319)</td>
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<td>Total Property and Equipment, Net</td>
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<td>828,904</td>
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<tr>
<td>Total Assets</td>
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<td>9,851,412</td>
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<td><strong>LIABILITIES AND NET ASSETS</strong></td>
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<tr>
<td>CURRENT LIABILITIES</td>
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<td>Accounts Payable and Accrued Expenses</td>
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<td>ACCRUED LEASE OBLIGATION (Net of Current Portion)</td>
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<td>NET ASSETS, UNRESTRICTED</td>
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<td>Undesignated</td>
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<td>Total Liabilities and Net Assets</td>
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### Statements of Activities

<table>
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<tr>
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<th>2017</th>
<th>2016</th>
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<tbody>
<tr>
<td><strong>REVENUE</strong></td>
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<td>Contracts and Grants</td>
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<td><strong>EXPENSES</strong></td>
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</tr>
<tr>
<td>Contracts and Grants</td>
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<tr>
<td>Personnel</td>
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<td>Other</td>
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<td>Institute Programs and Related Activities</td>
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<td><strong>Change in Net Assets</strong></td>
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<td>$ 286,549</td>
<td>$ 70,758</td>
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</table>

The accompanying notes of the Institute’s audited financial statements are an integral part of these financial statements. For a complete copy, write to: National Institute of Building Sciences, 1090 Vermont Avenue, NW, Suite 700, Washington, DC 20005-4950
# The Institute Staff

## Executive

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Henry L. Green</td>
<td>President, Hon. AIA</td>
</tr>
<tr>
<td>Holly A. Velez</td>
<td>Executive Assistant to the President</td>
</tr>
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</table>

## Administration

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>John G. Lloyd</td>
<td>Vice President/Chief Financial Officer</td>
</tr>
<tr>
<td>Ryan M. Colker, JD</td>
<td>Vice President</td>
</tr>
<tr>
<td>Gretchen Hesbacher</td>
<td>Editor/Director of Communications</td>
</tr>
<tr>
<td>Pamela R. Towns</td>
<td>Director, Marketing &amp; Publications</td>
</tr>
<tr>
<td>Patricia Prue</td>
<td>Manager, Accounting and Network Resources</td>
</tr>
<tr>
<td>Martha A. Smith</td>
<td>Administrative Services Specialist</td>
</tr>
</tbody>
</table>

## Technical Programs

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drew N. Rouland</td>
<td>Vice President, PMP, CSM</td>
</tr>
<tr>
<td>Dominique Fernandez</td>
<td>Program Director</td>
</tr>
<tr>
<td>Roger J. Grant, CSI, CDT</td>
<td>Program Director</td>
</tr>
<tr>
<td>Philip Schneider, AIA</td>
<td>Program Director</td>
</tr>
<tr>
<td>Stephanie Stubbs, Assoc. AIA, PMP</td>
<td>Program Director</td>
</tr>
<tr>
<td>Bob Payn</td>
<td>Director, Information Technology</td>
</tr>
<tr>
<td>Jiqiu “JQ” Yuan, PhD, PE, PMP</td>
<td>Project Manager</td>
</tr>
<tr>
<td>Kyle Barry, PMP</td>
<td>Project Manager</td>
</tr>
<tr>
<td>Tatyana Z.M. Calhoun</td>
<td>Associate Project Manager</td>
</tr>
<tr>
<td>DeeDee Banks</td>
<td>Web Production Specialist</td>
</tr>
</tbody>
</table>