ASHRAE and CIBSE Position Document on Resiliency in the Built Environment

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COMMITTEE ROSTER

The ASHRAE and CIBSE Position Document on Resiliency in the Built Environment was developed by ASHRAE's Resiliency in the Built Environment Position Document Committee formed on October 10, 2017, with David Underwood as its chair.

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Cognizant Committees

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HISTORY OF REVISION/REAFFIRMATION/WITHDRAWAL DATES

The following summarizes this document's revision, reaffirmation, and withdrawal dates:

6/26/2019—ASHRAE BOD approves Position Document titled *Resiliency in the Built Environment*

7/11/2019—CIBSE Board approves Position Document titled *Resiliency in the Built Environment*

6/26/2022—ASHRAE Technology Council reaffirms Position Document titled *Resiliency in the Built Environment*

6/26/2022—CIBSE Technology Committee reaffirms Position Document titled *Resiliency in the Built Environment*

Note: ASHRAE's Technology Council, CIBSE Technology Committee, and the cognizant ASHRAE committee recommend revision, reaffirmation, or withdrawal every 30 months.

Notes:

ASHRAE position documents are approved by the Board of Directors and express the views of the Society on a specific issue. The purpose of these documents is to provide objective, authoritative background information to persons interested in issues within ASHRAE's expertise, particularly in areas where such information will be helpful in drafting sound public policy. A related purpose is also to serve as an educational tool clarifying ASHRAE's position for its members and professionals, in general, advancing the arts and sciences of HVAC&R.

CIBSE develops statements outlining our position on topical issues relevant to the built environment. These are based on research and evidence and we draw on the knowledge and experience of our membership to provide expert guidance to decision makers. Each statement provides clear recommendations and focuses on actions that could and should be implemented.

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ABSTRACT

As defined in the National Academy of Sciences report *Disaster Resilience: A National Imperative*, resiliency is "the ability to prepare and plan for, absorb, recover from and more successfully adapt to adverse events or threats." These events or threats may be financial, political, or environmental, as well as disaster, conflict, or climate related. Resiliency will continue to have major impacts on how the built environment, and engineered systems in buildings, are designed and operated. Its recent prominence is due in part to increasing concerns over the adequacy of responses to extreme events around the world, as well as recognition that many such events are likely to increase in frequency and severity in the future. ASHRAE's and CIBSE's position is that building design and operation must consider resiliency as part of an overall risk assessment and planning approach and that major new efforts in research, education, standards, and guidance development are required to increase building resiliency.

EXECUTIVE SUMMARY

Throughout its life, a building may be subjected to short-term or long-term stressors that are beyond the original design intent. Given the existence of these stressors, it is important to achieve and preserve resiliency in the built environment, whether designing new buildings, refurbishing or retrofitting buildings, or managing the recovery of damaged buildings.

ASHRAE's and CIBSE's positions on resiliency are as follows:

- Resiliency is an increasingly important societal, economic, and technical issue that will have major impact on how built environments in general, and engineered systems in buildings, are designed and operated.
- Technical solutions to these challenges are needed, including research, standards and guidelines, and educational materials.
- Policy-setting entities worldwide need to encourage sound, balanced, and innovative actions to address broad issues of resiliency and the specific technical concerns associated with them.
- Built environments need to be developed which are both resilient and sustainable.

In addition to these positions, ASHRAE and CIBSE make several specific recommendations in the document for advancing the knowledge and effectiveness of our actions to increase resiliency in the built environment. These include collaborations with other organizations and disciplines, research, education and training, and engagement with policy makers.

1. THE ISSUE

The building community currently faces the challenge of improving resiliency and performance in the built environment, given its vulnerability to natural and human-induced events. The threats to the built environment that must be considered in attempts to improve resilience include events such as floods, earthquakes, severe storms, and attacks. These threats and the need for disaster preparedness, response, recovery, mitigation, and adaption are discussed in a 2012 report by the National Academy of Sciences.[1] Approaches to improving building resilience need to account for the building's role in the community during normal times as well as during recovery following disruptive events, in addition to other critical goals such as sustainability and indoor environmental quality. Functional goals for buildings after an adverse event (e.g., the building is functional within X days of the event) will inform the functional goals for the building and its systems.

2. BACKGROUND

Resiliency in the built environment is a complex subject that involves many disciplines. Its recent prominence is in part due to increasing concerns over the adequacy of responses to natural or climate-related events around the world, as well as recognition that many such events are likely to increase in frequency and severity.[2] The National Academy of Sciences report *Disaster Resilience: A National Imperative* defines resiliency as "the ability to prepare and plan for, absorb, recover from and more successfully adapt to adverse events or threats".[1] ASHRAE is a founding member of a large coalition of industry organizations who have a documented commitment to resiliency in the built environment (AIA and NIBS).[3] The United Kingdom has national guidance titled *Resilience in society: infrastructure, communities and businesses*,[4] to which CIBSE has contributed.

ASHRAE's and CIBSE's interest in resilience has been heightened by recent catastrophic natural events, the impacts and prospects of climate change, and concerns about human-induced episodes. Our interest has also been enhanced by increased societal interest in environmental protection and energy conservation.

Resiliency in the built environment has become an industry-wide concern, and ASHRAE and CIBSE have critical roles to play. Both organizations already have significant and unique technical expertise on how buildings and engineering systems in buildings are affected by resiliency concerns and how they can be designed and operated in response to the various stressors involved, as reflected in their widely referenced handbooks, guidelines, and standards (see the Bibliography section).

The goals of both organizations, as reflected in this position document, are to create built environments that are more resilient to adverse events and changes over time by

- describing what ASHRAE and CIBSE are doing to address challenges in creating a resilient built environment in the context of climate change and natural- or human-induced disasters and
- identifying design and operational strategies to achieve resiliency in the built environment, including infrastructure and associated systems.

Throughout its life, a building may be subjected to short-term or long-term stressors that are beyond the original design intent, including both natural- and human-induced events. Community stakeholders such as government leaders, building owners, designers, and occupants as well as other stakeholders in the building community need strategies, design practices, and other tools to make buildings more resilient. More resilient buildings will resist damage, be more adaptable to changing conditions and climate, and, importantly, protect their occupants during extreme events and recovery.

The stressors that are motivating the need to address building resiliency are diverse and changing. Events such as hurricanes, earthquakes, floods, and wildfires have resulted in the loss of thousands of lives and have caused billions of dollars in damage to buildings and other infrastructure. In some cases, the negative consequences have been exacerbated by poor planning and site locations of buildings. The short-term and long-term consequences of these events include building damage or destruction, public health impacts, displacement of people, and loss of local expertise to address the problems.

Events such as physical and cyber attacks and compromised electrical supply have cost billions of dollars in lost productivity and societal disruption. The short-term and long-term consequences of these events include personal trauma, cyber and other security breaches, lengthy power outages, failure of infrastructure outside of the building, and decreased ability to return facilities to their intended uses following an event.

Innovations in building technology and design practice can provide practical ways to increase the resiliency of new structures or to retrofit and upgrade existing ones. In developing these innovations, it is critical to acknowledge that buildings do not operate in isolation; they require energy (e.g., gas and electricity), water, and methods of getting rid of waste, including sewage. In other words, building design and operation are inexorably linked with the natural and man-made environment in which the building is situated. Engineers and building owners must have contingency plans in place that recognize the negative impacts that may result if the local infrastructure cannot support the functions of their facilities.

When considering options for increasing the resiliency of a specific building, it is also important for the owner and their design team to consider the role of that building in its community, with the expectation that more critical buildings will justify more investment in resiliency. Information for conducting such community resilience planning is available at www.nist.gov/topics/community-resilience.[5] Types of buildings requiring more investment and detailed consideration include hospitals, fire stations, and emergency medical facilities, for example.

Resiliency goals are directly linked to those of sustainable built environments. By addressing resiliency in the built environment, ASHRAE and CIBSE members and other stakeholders in HVAC&R and sustainable built environments must promote and encourage the following:

- Effective recovery of existing buildings with minimal environmental impact
- Reduction of unwanted or unintended events affecting existing or new buildings
- Sustainable use of resources in building design and operation that improve the resiliency of the built environment

Much of the damage to buildings and surrounding infrastructure occurs in the days and weeks following an event because clean-up efforts are hampered by the scale of the event, lack of qualified technicians, limited access, damaged infrastructure, or a lack of knowledge about the proper techniques for mitigating the aftereffects. Mold growth, damage to foundations, smoke damage, and poor indoor air quality may result in the need to completely replace a structure rather than repair it. Knowledge exists within ASHRAE and CIBSE to aid in the development of recovery plans at the community, campus, and structural levels to speed up response time, reduce damage, and hasten the return of the structure to its intended use.

With over 56,000 members in 132 nations, ASHRAE is a diverse organization representing professionals in the areas of building design, operation, and maintenance. Along with its partner organizations, it has a unique opportunity to lead in the proactive development of a resilient built environment.

CIBSE has over 20,000 members in approximately 100 countries, who work in heating, ventilating, air conditioning, public health, lighting, fire safety, and vertical transportation and are involved in the design, manufacture, installation, operation, maintenance, and refurbishment of all these components of buildings and infrastructure systems.

3. RECOMMENDATIONS

ASHRAE and CIBSE hold the following strong positions:

- Resiliency is an increasingly important societal, economic, and technical issue that will have a major impact on how built environments in general, and engineered systems in buildings, are designed and operated.
- Technical solutions to these challenges are needed, including research, standards and guidelines, and educational materials.
- Policy-setting entities worldwide need to encourage sound, balanced, and innovative actions to address broad issues of resiliency and the specific technical concerns associated with them.
- Built environments need to be developed which are both resilient and sustainable.

ASHRAE, CIBSE, and other stakeholders should support research to develop enhanced resiliency in the following areas:

- Design and operation of HVAC&R and other building systems to extend beyond increasing energy efficiency and occupant health and comfort to address life-cycle costs, resistance to extreme events, and continued operation and/or reduced recovery time in the event of catastrophic events and in the face of climate change
- Envelope design and maintenance that supports resistance to and recovery from extreme events
- Site considerations, including both overall building site and HVAC&R locations within a building, that may affect building performance

ASHRAE and CIBSE are committed to the following actions:

- Taking a leadership role in responding to resiliency issues in the built environment
- Developing and adopting designs, materials, components, systems, and processes that minimize the adverse impacts of extreme events and environmental changes over time
- Developing plans that address the recommendations in this position document, including research, education, and advocacy, and that set priorities for funding and implementation
- Actively engaging and collaborating with other organizations worldwide to encourage sound, balanced, and innovative actions to address resiliency

4. REFERENCES

1. National Academy of Sciences. 2012. *Disaster Resilience: A National Imperative*. Washington DC, USA: National Academies Press.

2. IPCC. 2014. Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva, Switzerland: Intergovernmental Panel on Climate Change. www.ipcc.ch/report/ar5/.
3. AIA and NIBS. 2014. Industry Statement on Resilience. Washington DC, USA: American Institute of Architects and National Institute of Building Sciences. www.ashrae.org/File%20Library/Technical%20Resources/Resiliance%20Activities/Statement_2016-0425.pdf.
4. HM Government Cabinet Office. 2013. *Resilience in society: infrastructure, communities and businesses*. London, UK: HM Government Cabinet Office. www.gov.uk/guidance/resilience-in-society-infrastructure-communities-and-businesses.
5. NIST. 2016. *Community Resilience Planning Guide for Buildings and Infrastructure Systems*. NIST SP 1190. Gaithersburg, MD, USA: National Institute of Standards and Technology.

5. BIBLIOGRAPHY

5.1 ASHRAE Resources

- ANSI/ASHRAE/IES Standard 100, *Energy Efficiency in Existing Buildings*, which sets criteria to reduce energy consumption through improved energy efficiency and performance.
- ANSI/ASHRAE/IES Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings*
- ANSI/ASHRAE/IES Standard 90.2, *Energy-Efficient Design of Low-Rise Residential Buildings*
- ANSI/ASHRAE Standard 90.4, *Energy Standard for Data Centers*
- Building EQ, www.ashrae.org/buildingeq, which is a building energy rating program that provides both an operational and an asset rating to assess a building's energy performance. Beyond providing a score, Building EQ can help improve a building's energy performance after the benchmarking is completed. The Building EQ In Operation rating assists with an ASHRAE Level 1 energy audit and provides both a standardized process and actionable recommendations for the building.
- ANSI/ASHRAE Standard 135, *BACnet—A Data Communication Protocol for Building Automation and Control Networks*, which defines data communication services and protocols for information technology used to monitor building systems and to ensure all building automation systems can "talk" to one another.
- 2018 *International Green Construction Code* (powered by ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1, *Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings*)
- ANSI/ASHRAE Standard 171, *Method of Testing for Rating Seismic and Wind Restraints*
- Advanced Energy Design Guide (AEDG) series
- *ASHRAE GreenGuide*
- ASHRAE Handbook chapters relevant to resiliency issues:
  - 2017 *ASHRAE Handbook—Fundamentals*
    - Chapter 10, Indoor Environmental Health
    - Chapter 35, Sustainability
  - 2015 *ASHRAE Handbook—HVAC Applications*
    - Chapter 39, Operation and Maintenance Management

    - Chapter 59, HVAC Security
    - Chapter 61, Smart Building Systems
- ASHRAE Weather Data Center, www.ashrae.org/weatherdata

5.2 CIBSE Resources

To access the CIBSE resources listed here, visit the CIBSE Knowledge Portal at www.cibse.org/knowledge.

- CIBSE Guide A: Environmental Design
- CIBSE Guide L: Sustainability
- CIBSE Guide M: Maintenance engineering and management
- CIBSE TM36 Climate Change & the Indoor Environment: Impacts & Adaptation
- CIBSE TM40 Health Issues in Building Services
- CIBSE TM48 Use of Climate Change Scenarios for Building Simulation
- CIBSE TM49 Design Summer Years for London
- CIBSE TM52 Limits of Thermal Comfort: Avoiding Overheating
- CIBSE TM55 Design for Future Climate: Case Studies
- CIBSE TM56 Resource Energy Efficiency of Building Services
- CIBSE TM59 Design Methodology for the Assessment of Overheating Risk in Homes
- CIBSE Weather Data Sets