

ANSI/ASHRAE/USGBC/IES Standard 189.1-2011

# Standard for the Design of High-Performance Green Buildings

Except Low-Rise Residential Buildings



A Jurisdictional Compliance Option of the International Green Construction Code™

See Appendix I for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, the U.S. Green Building Council, the Illuminating Engineering Society of North America, and the American National Standards Institute.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site (www.ashrae.org), or in paper form from the ASHRAE Manager of Standards.

The latest edition of an ASHRAE Standard may be purchased on the ASHRAE Web site (www.ashrae.org) or from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305, telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in the United States and Canada), or e-mail: orders@ashrae.org. For reprint permission, go to www.ashrae.org/permissions.

© 2011 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. and U.S. Green Building Council



ASHRAE Standing Standard Project Committee 189.1 Cognizant TC: TC 2.8, Building Environmental Impacts and Sustainability SPLS Liaison: Rita M. Harrold/Allan B. Fraser ASHRAE Staff Liaison: Bert E. Etheredge IES Liaison: Rita M. Harrold USGBC Liaison: Brendan Owens

#### Name

## Affiliation

Dennis Stanke, Chair\*

Richard Heinisch, Vice Chair \* Dan Nall, Vice Chair\* Andrew Persily, Vice Chair \* Leon Alevantis\*

Jim Bowman\*

Harvey Bryan\* Ron Burton (BOMA)\* Dimitri Contoyannis\* Dru Crawley\* John Cross\*

Lance DeLaura\*

Charles Eley (AIA)\*

Anthony Floyd\* Susan Gitlin\*

Gregg Gress\* Donald Horn\*

Roy Hubbard\* John Koeller\* Michael Jouaneh\* Tom Lawrence\* Neil Leslie\* Bing Liu\*

Richard Lord\* Merle McBride\* Jim McClendon\* Molly McGuire\* Jonathan McHugh\* Teresa Rainey\* Steve Rosenstock (EEI)\* Jeff Ross-Bain\* Lawrence Schoen\* Boggarm Setty\* Wayne Stoppelmoor\*

Trane Commercial Systems, Ingersoll-Rand Acuity Brands Lighting WSP Flack+Kurtz NIST California Department of Public Health American Forest & Paper Association, Inc. Arizona State University BOMA International IES **Bentley Systems** American Institute of Steel Construction Southern California Gas Company Architectural Energy Corporation City of Scottsdale U.S. Environmental Protection Agency International Code Council U.S. General Services Administration Johnson Controls Inc. Koeller and Company Lutron University of Georgia Gas Technology Institute Pacific Northwest National Laboratory UT Carrier Corp **Owens Corning** Walmart Stores Taylor Engineering McHugh Energy Consultants Skidmore Owing Merrill Edison Electric Institute Ross-Bain Green Building Schoen Engineering Inc. Setty & Associates Schneider Electric

#### Name

Martha VanGeem\* David Viola\* Susan Anderson Ernie Conrad Julia Beabout James Benya Lee Burgett

Paula Cino Steven Clark Daryn Cline Peyton Collie

Peter Dahl Michael DeWein

William Dillard Nicola Ferzacca Katherine Hammack Josh Jacobs Stephen Kennedy Carl Lawson Mark MacCracken Thomas Marseille Kent Peterson John Pulley Jeffery Rutt Harvey Sachs

Joshua Saunders Charles Seyffer Melanie Shepherdson

Swati Ogale Jeffrey Stone

Christian Taber Robert Thompson

Robert Timmerman Timothy Wentz David Williams Steven Winkel

#### Affiliation

CTLGroup IAPMO Osram Sylvania Landmark Facilities Simulated Solutions Benya Lighting Design Trane Commercial Systems, Ingersoll-Rand National Multi Housing Council Aquatherm Evapco Inc. Sheet Metal and Air Conditioning Contractor's National Association Sebesta Blomberg **Building Codes** Assistance Project Mechanical Services of Florida Architecture Engineers Ernst and Young GREENGUARD Georgia Power Hanson Professional Services Calmac Manufacturing Corp WSP F + K P2S Engineering Inc. HOK U.S. Department of Defense American Council for an Energy-Efficient Economy **Underwriters** Laboratories Camfil Farr Natural Resource **Defense Council** Ecoways Consulting, Ltd., UK American Forest & Paper Association **Big Ass Fans** U.S. Environmental **Protection Agency** AtSite Real Estate University of Nebraska LHB Inc. The Preview Group

\* Denotes members of voting status when the document was approved for publication

#### ASHRAE STANDARDS COMMITTEE 2011–2012

Krishnan Gowri

Carol E. Marriott, *Chair* Kenneth W. Cooper, *Vice-Chair* Douglass S. Abramson Karim Amrane Charles S. Barnaby Hoy R. Bohanon, Jr. Steven F. Bruning David R. Conover Steven J. Emmerich Allan B. Fraser

Maureen Grasso Cecily M. Grzywacz Richard L. Hall Rita M. Harrold Adam W. Hinge Debra H. Kennoy Jay A. Kohler Frank Myers Janice C. Peterson Douglas T. Reindl Boggarm S. Setty James R. Tauby James K. Vallort William F. Walter Michael W. Woodford Craig P. Wray Eckhard A. Groll, *BOD ExO* Ross D. Montgomery, *CO* 

Stephanie C. Reiniche, Manager of Standards

#### SPECIAL NOTE

This American National Standard (ANS) is a national voluntary consensus standard developed under the auspices of the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). *Consensus* is defined by the American National Standards Institute (ANSI), of which ASHRAE is a member and which has approved this standard as an ANS, as "substantial agreement reached by directly and materially affected interest categories. This signifies the concurrence of more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered, and that an effort be made toward their resolution." Compliance with this standard is voluntary until and unless a legal jurisdiction makes compliance mandatory through legislation.

ASHRAE obtains consensus through participation of its national and international members, associated societies, and public review. ASHRAE Standards are prepared by a Project Committee appointed specifically for the purpose of writing the Standard. The Project Committee Chair and Vice-Chair must be members of ASHRAE; while other committee members may or may not be ASHRAE members, all must be technically qualified in the subject area of the Standard. Every effort is made to balance the concerned interests on all Project Committees.

The Manager of Standards of ASHRAE should be contacted for:

- a. interpretation of the contents of this Standard,
- b. participation in the next review of the Standard,
- c. offering constructive criticism for improving the Standard, or
- d. permission to reprint portions of the Standard.

#### DISCLAIMER

ASHRAE uses its best efforts to promulgate Standards and Guidelines for the benefit of the public in light of available information and accepted industry practices. However, ASHRAE does not guarantee, certify, or assure the safety or performance of any products, components, or systems tested, installed, or operated in accordance with ASHRAE's Standards or Guidelines or that any tests conducted under its Standards or Guidelines will be nonhazardous or free from risk.

## ASHRAE INDUSTRIAL ADVERTISING POLICY ON STANDARDS

ASHRAE Standards and Guidelines are established to assist industry and the public by offering a uniform method of testing for rating purposes, by suggesting safe practices in designing and installing equipment, by providing proper definitions of this equipment, and by providing other information that may serve to guide the industry. The creation of ASHRAE Standards and Guidelines is determined by the need for them, and conformance to them is completely voluntary.

In referring to this Standard or Guideline and in marking of equipment and in advertising, no claim shall be made, either stated or implied, that the product has been approved by ASHRAE.

## CONTENTS

# ANSI/ASHRAE/USGBC/IES Standard 189.1-2011 Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

SECTION	PAGE
Foreword	2
1 Purpose	
2 Scope	5
3 Definitions, Abbreviations, and Acronyms	6
4 Administration and Enforcement	
5 Site Sustainability	
6 Water Use Efficiency	
7 Energy Efficiency	
8 Indoor Environmental Quality (IEQ)	
9 The Building's Impact on the Atmosphere, Materials, and Resources	
10 Construction and Plans for Operation	
11 Normative References	
Normative Appendix A: Prescriptive Building Envelope Tables	51
Normative Appendix B: Prescriptive Continuous Air Barrier	70
Normative Appendix C: Prescriptive Equipment Efficiency Tables	71
Normative Appendix D: Performance Option for Energy Efficiency	
Normative Appendix E: IAQ Limit Requirements for Office Furniture Systems and Seating	
Normative Appendix F: Building Concentrations	
Informative Appendix G: Informative References	
Informative Appendix H: Integrated Design	
Informative Appendix I: Addenda Description Information	

## NOTE

Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE Web site at www.ashrae.org/technology.

© 2011 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 1791 Tullie Circle NE Atlanta, GA 30329 www.ashrae.org All rights reserved. (This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

## FOREWORD

ANSI/ASHRAE/USGBC/IES Standard 189.1 was created through a collaborative effort involving ASHRAE, the U.S. Green Building Council, and the Illuminating Engineering Society of North America. Like its 2009 predecessor, the 2011 version of the standard is written in code-intended (mandatory and enforceable) language so that it may be readily referenced or adopted by enforcement authorities to provide the minimum acceptable level of design criteria specifically for high-performance green buildings within their jurisdiction. States and local jurisdictions within the United States that wish to adopt Standard 189.1 into law may want to review applicable federal laws regarding preemption and related waivers that are available from the U.S. Department of Energy (www1.eere.energy.gov/buildings/appliance\_standards/ state\_petitions.html).

Building projects in general, including their design, construction, and operation, result in potentially significant energy and environmental impacts. Development frequently converts land from biologically diverse natural habitat to impervious hardscape with greatly reduced biodiversity. The U.S. Green Building Council has reported that buildings in the United States produce 39% of U.S. carbon dioxide (CO2) emissions, are responsible for 40% of U.S. energy consumption, account for 13% of U.S. water consumption, and contribute 15% to GDP per year.

While buildings increase the national energy and environmental footprint, they also contribute significantly to the national economy and offer great potential for reducing energy use, greenhouse gas emissions, water use, heat island and light pollution effects, and impacts on the atmosphere, materials, and resources.

The far-reaching influence of buildings leads to calls for action to reduce their energy and environmental impact. To help meet its ongoing responsibility to support such actions, ASHRAE Standing Standard Project Committee (SSPC) 189.1 uses the ASHRAE continuous maintenance process to update this standard in response to input from all segments of the building community, the public at large, and project committee members. Compliance with these updated provisions will further reduce negative energy and environmental impacts through high-performance building design, construction, and operation.

The project committee members and consultants considered a variety of factors to develop the provisions of this standard, including published research, justification for proposals received from outside the committee, and the committee members' professional judgment. However, new provisions within the standard were not uniformly subjected to economic assessment. Cost-benefit assessment, while an important consideration in general, was not a necessary criterion for acceptance of any given proposed change to the standard. The development of an economic threshold value associated with the energy or environmental benefit of each provision falls outside the scope of this standard.

Standard 189.1 addresses site sustainability, water use efficiency, energy use efficiency, indoor environmental quality (IEQ), and the building's impact on the atmosphere, materials, and resources. The standard devotes a section to each of these subject areas, as well as a separate section related to plans for construction and high-performance operation.

Many of the provisions of this 2011 version of the standard differ from those of the 2009 version. New provisions include the following:

- Since Standard 189.1 adopts by reference many requirements from other ASHRAE standards (particularly Standards 62.1 and 90.1), this version updates requirements to reflect the most current version of each referenced standard. Most importantly, it refers to Standards 90.1-2010 and 62.1-2010 rather than the 2007 version of each.
- The standard limits the requirement for condensate recovery from mechanical cooling equipment to regions where significant amounts of condensate can be expected based on climate conditions.
- The standard replaces the Standard 90.1 across-theboard approach to reduction in interior lighting power density (LPD) with an LPD reduction based on specific building and space types.
- For lighted signs visible during daytime hours, automatic controls are now required to reduce the lighting power to 35% of full power. For other signs, automatic controls must now turn off lighting during daytime hours and reduce the lighting power to 70% of full power after midnight.
- For hotel guest rooms, automatic controls are now required to turn off power for lighting, television, and switched outlets and to reset HVAC setpoints within 30 minutes after the guest room becomes unoccupied.
- As an alternative to permanent projections for shading, building projects may now employ automatically controlled building façade systems, such as dynamic glazing and shading systems, which modify solar heat gain factor (SHGF) in response to daylight levels or solar intensity.
- Additional federal minimum efficiency requirements for commercial refrigeration equipment, effective January 1, 2012, have been incorporated into Table C-16.
- Prescribed on-site renewable energy must be based on roof area rather than conditioned space area, and the renewable energy requirement for multiple-story buildings now exceeds the requirement for single-story buildings.
- Invasive plants-those not indigenous to the building sitemust be removed from the building site and destroyed.
- Open-graded (uniformed size) aggregate and porous pavers (e.g., open-grid pavers) qualify as a hardscape

surface for heat island mitigation with no further testing. Permeable pavement and permeable pavers must meet a minimum percolation rate rather than a minimum solar reflectance index (SRI).

- Roofs must meet both an initial and an aged (three year) minimum solar reflectance index.
- Pedestrian walkways must be provided to connect transit stops to primary building entrances.

As was the case in the 2009 version of the standard, each section follows a similar format:

*x.1 General. This subsection includes a statement of scope and addresses other broad issues for the section.* 

*x.2 Compliance Paths. This subsection indicates the compliance options available within a given section.* 

**x.3** Mandatory Provisions. This subsection contains mandatory provisions that apply to all projects (i.e., provisions that must be met and may not be ignored in favor of equal or more stringent provisions found in other subsections).

**x.4 Prescriptive Option.** This subsection-an alternative to the Performance Option-contains prescribed provisions that must be met in addition to all mandatory provisions. Prescribed provisions offer a simple compliance approach that involves minimal calculations.

**x.5** *Performance Option.* This subsection-an alternative to the Prescriptive Option-contains performance-based provisions that must be met in addition to all mandatory provisions. Performance provisions offer a more complex alternate compliance approach that typically involves simulation or other calculations.

SSPC 189.1 considers and administers changes to this continuous maintenance standard and provides interpretations as requested. Proposed changes to the standard may originate within or outside of the committee. The committee welcomes proposals for improving the standard using the ANSI-approved ASHRAE continuous maintenance procedure. A continuous maintenance proposal (CMP) form can be found online at http://www.ashrae.org/technology/page/97 as well as in the back of this standard, and may be completed and submitted at any time. The committee takes formal action on every proposal received, which often results in changes to the published standard. ASHRAE posts approved addenda in publication notices on the ASHRAE Web site. To receive notice of all public reviews, approved and published addenda, errata, and interpretations as well as meeting notices, ASHRAE encourages interested parties to sign up for the free ASHRAE Internet Listserv for this standard (http://www.ashrae.org/ publications/detail/14931).

# 1. PURPOSE

The purpose of this standard is to provide minimum requirements for the siting, design, construction, and plan for operation of high-performance green buildings to:

- a. balance environmental responsibility, resource efficiency, occupant comfort and well being, and community sensitivity, and
- b. support the goal of development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

## 2. SCOPE

- **2.1** This standard provides minimum criteria that:
- a. apply to the following elements of *building projects*:
  - 1. new buildings and their systems
  - 2. new portions of buildings and their systems
  - 3. new systems and equipment in existing buildings
- b. address *site* sustainability, water use efficiency, energy efficiency, indoor environmental quality (IEQ), and the building's impact on the atmosphere, materials, and resources.
- **2.2** The provisions of this standard do not apply to:
- a. single-family houses, multi-family structures of three stories or fewer above grade, manufactured houses (mobile homes) and manufactured houses (modular), and
- b. buildings that use none of the following: electricity, fossil fuel, or water.

**2.3** This standard shall not be used to circumvent any safety, health, or environmental requirements.