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## Designing high-performance buildings using **189.1**

ASHRAE Standard 189.1 sets the standard for the total building sustainability package.

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Industry standards set by ASHRAE and Illuminating Engineering Society (IES) have been integrated into the U.S. Green Building Council (USGBC) LEED baseline references since the original development of the LEED rating system.

In the 15 years since the USGBC introduced the pilot version of the LEED rating system, these three organizations have continuously worked together to keep the standards moving in the direction of performance and efficiency. At the same time, technology, design, and construction have evolved in response to these changes.

In 2009, when ASHRAE, IES, and USGBC introduced Standard 189.1: Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings, it was a significant step, marking the first time that high-performance green building characteristics had been developed as code-enforceable language. ASHRAE has since released Standard 189.1-2011, which supersedes the original version and is listed as an alternative compliance path in the 2012 International Green Construction Code (IgCC).

Unless a jurisdiction in which you regularly engineer and design buildings has adopted or is considering adopting Standard 189.1 or IgCC as part of its code requirements for permit and occupancy, Standard 189.1 may not have an impact on your current projects. Regardless, the fact that it is now an option for jurisdictions to consider makes it important for building design industry professionals to have a basic understanding of what it entails. It is equally important to monitor the code adoption plans and procedures of the jurisdictions where you provide service to make

sure you have the chance to review and comment on proposed changes.

As a standard, 189.1-2011 provides guidelines and minimum requirements for the design of high-performance green buildings except low-rise residential buildings. For the purposes of this overview, the standard will be reviewed in its native form of ASHRAE Standard 189.1.

It is important to remember that compared to ASHRAE Standard 90.1, 189.1 covers many aspects of construction beyond energy use. Standard 189.1 includes provisions for site sustainability, water efficiency, indoor environmental quality, materials and resources, and commissioning in addition to energy use. As jurisdictions begin to adopt 189.1 either directly or through the IgCC, these sections will have to be considered against existing regional agencies, departments, and regulations. For example, most jurisdictions have zoning laws on the books that may contradict the site development requirements of 189.1.

Standard 189.1 is divided into 11 sections and is supported by nine appendices. Sections one through four cover the purpose, scope, definitions of key terms, and administration of the standard; Section 11 contains a listing of all other standards referenced in the document, detailing the location of the reference and its responsible governing body.

If you have worked with LEED, the remaining sections are broken into categories that will look familiar: Site Sustainability, Water Use Efficiency, Energy Efficiency, Indoor Environmental Quality, Impact on Atmosphere, Materials and Resources, and Construction Plans for Operation.

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# Codes & Standards

Each section has a collection of mandatory provisions that must be met in order to comply, and with the exception of Construction and Plans for Operation, each section offers both prescriptive and performance options for compliance. Construction and Plans for Operation includes only mandatory provisions.

**SECTION 5 - Site Sustainability:** This section covers preferred building sites (greenfield versus brownfield), roofs and site hardscape, light pollution, and plant species located on the project site with the intent of improving site selection and development, minimizing heat island impact, and reducing light pollution.

**SECTION 6 - Water Use Reduction:** All site and building-related potable and non-potable water consumption, including outdoor water use for irrigation and irrigation system design and controls, is covered in this section. Maximum allowable flow rates are provided for various types of plumbing fixtures. In addition, water-consuming appliances, mechanical systems, medical systems, and roof irrigation are addressed.

**SECTION 7 - Energy Efficiency:** This section outlines requirements for building energy efficiency, on-site renewable energy systems, and energy monitoring, and largely defers to the requirements of ASHRAE Standard 90.1. Provisions that go beyond the performance requirements of 90.1 include exterior wall and roof performance; fenestration performance, area, and orientation; HVAC system efficiency; and lighting power density. In addition to the systems covered by Standard 90.1, this section includes requirements for energy consumption metering, provisions for on-site renewable energy, and horizontal and vertical projections on the exterior. When using the performance option, an energy cost comparison alone is not allowed. The engineer must also demonstrate that the CO<sub>2</sub> produced by operating the model building will not exceed that of a baseline model.

**SECTION 8 - Indoor Environmental Quality:** In this section, you will find requirements for eliminating environmental tobacco smoke, preventing particulate contamination from entering the building (through walk-off mats and mechanical filtration), monitoring ventilation rates, reducing material volatile organic compound (VOC) levels, and daylighting provisions. The section also contains acoustical control requirements

## IgCC's origins

The International Code Council (ICC) first introduced the public version of the International Green Construction Code (IgCC) in 2010. After undergoing two rounds of public comment, a full cycle of code development was held in 2011, which was followed by the official release of the 2012 IgCC to provide "model code regulations that contain clear and specific requirements with provisions that promote safe and sustainable construction in an integrated fashion with the ICC Family of Codes." The code is currently slated to be formally updated and re-released every three years.

that focus on limiting sound transmission between different areas. The first acoustical control requires sound attenuation between the inside of the building and the outdoors when located near high-noise sources (e.g., expressways and airports). This is mandated in the form of wall, roof, and fenestration sound transmission class (STC) ratings. Interior sound (between spaces) is controlled through STC-rated partitions between dwelling units, and between assembly areas, such as conference rooms, and other use areas.

**SECTION 9 - Impact on the Atmosphere, Materials, and Resources:** Provisions for the handling of materials range from sourcing (location, biobased, and wood certification) to end of life (waste diversion, recycling, and total waste amount for a construction project). Ozone-depleting characteristics of components such as refrigerants are addressed in this section. As an alternative to the prescriptive path for materials, a lifecycle assessment

(LCA) can be performed comparing at least two alternative constructions covering the material components addressed by the prescriptive path and compliant with Sections 6, 7, and 8 and the mandatory requirements of Section 9. Performing an LCA for Atmosphere, Materials, and Resources is analogous to performing an energy model for the building energy efficiency. That is, the LCA provides designers with more freedom to exceed the performance requirements of the standard by not being limited to the prescriptive path. In the LCA, the accepted alternative must demonstrate a 5% improvement over the prescriptive building alternate in at least two of the impact categories: land use, resource use, climate change, ozone layer depletion, human health effects, ecotoxicity, smog, acidification, and eutrophication. The section references ISO Standard 14044 for performing the LCA.

**SECTION 10 - Construction and Plans for Operation:** All provisions listed in this section are mandatory. Construction primarily covers construction activities and the commissioning effort and includes controlling moisture on the construction site, limiting vehicle idling, erosion and sediment control, and indoor air quality control. The commissioning portion outlines the commissioning process and identifies what systems must be commissioned. Plans for Operation tackles post-occupancy activities required to keep the building operating as it was designed throughout the building life. There are six main systems that are identified to be commissioned: mechanical systems, lighting systems, fenestration control systems (automatic shades and dynamic glazing), renewable energy systems, water measurement devices, and energy measurement devices.

Plans for Operation starts with developing a high-performance building operation plan. In addition to tracking and recording energy and water use, site sustainability must be maintained through preservation of site vegetation. Indoor environmental quality is to be maintained through outdoor airflow measurement

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and indoor air quality maintenance. Finally, a maintenance plan must be developed and implemented that covers the building mechanical, electrical, and plumbing systems. This section is important because as the building systems become more complex to reduce energy use and improve indoor environmental quality, it is necessary that these systems function as they were designed. Otherwise, system perfor-

**2.** The distinction of 189.1 as a code-enforceable document is important in understanding its relationship to LEED. Building codes provide a minimum standard of care and safety for buildings and their occupants. Their enforcement affects the ability to obtain permits to begin construction and for occupancy after construction is complete. This is in stark contrast to projects voluntarily pursuing LEED certification, which must

inspired outline similar to 189.1 and follows the format of other ICC codes. That familiar format—combined with the fact that the IgCC, in section 301.2, allows 189.1 as an alternative compliance path—makes it an appealing option for jurisdictions already using the ICC based code templates.

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**Their enforcement affects the ability to obtain permits to begin construction and for occupancy after construction is complete.**

mance will suffer and with it the energy use will increase, indoor environmental quality will decrease, and there will be a negative impact on the surrounding environment.

## Standard 189.1 and LEED

The value systems of 189.1 and the LEED rating systems are intrinsically connected. This is obvious in the shared categories that they address. Simply put, LEED raised the level of conversation about sustainable building design and established it as a common practice in the building industry. Now, ASHRAE Standard 189.1 translates those principles into a design standard ready for code adoption. Taking a deeper look, there are several important distinctions to understand:

**1.** LEED was developed as a voluntary program, and organizations made a choice to participate as a way to show a commitment to sustainability. Though mandates to obtain LEED certification for some government facilities do now exist, LEED is still optional for most commercial and institutional projects. 189.1 is a tool that allows jurisdictions to adopt these high-performance building characteristics through enforceable building codes.

submit preliminary information during design, but do not undergo a final review until after the design and construction is completed, and are not prevented from being occupied if they are not awarded certification.

**3.** The LEED rating system provides the flexibility to pursue a variety of credits to achieve certification but, other than prerequisites, does not dictate which sustainable design principles a project must emphasize. 189.1 is not a credit system; it is a complete model standard. To fully comply with the 189.1 standard, the design needs to address every element through both mandatory requirements and either a prescriptive or performance path.

**4.** A governing jurisdiction can elect whether to implement 189.1 language as-is into code or customize elements to create its own standards. Project teams pursuing LEED certification do not have the opportunity to make wholesale changes to the language or process.

## Standard 189.1 and IgCC

In addition to Standard 189.1, jurisdictions have the option to adopt the International Code Council's (ICC) IgCC to enforce minimum green building standards. The IgCC follows a LEED-


## What's next

Although ASHRAE Standard 189.1 may not immediately impact your projects, it is important to be aware of its requirements and intent and pay close attention to whether or not local code officials are considering its (or the IgCC's) adoption. Be sure to understand how code changes are adopted and implemented in your jurisdiction. Staying ahead of the implementation of potentially significant changes such as these will provide time both to internally adjust to the new requirements and to educate clients on how future projects may be affected.

Get involved in the process if possible, whether providing comments during public review periods, attending public meetings, or applying to serve as a volunteer member of a local code advisory board. The more you know about the change, the more prepared you will be to minimize the impact on your firm and your clients.

**lcsel**

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Read the longer version of this online at: [www.csemag.com/archives](http://www.csemag.com/archives).

Learn how the District of Columbia turned ASHRAE Standard 189.1 into code.