Industry-driven standards and codes are the foundation for quality, safety and sustainability in construction projects worldwide. ASTM International is helping buildings rise and operate in an efficient and environmentally friendly way.
Standards for Sustainable Construction

13%
Industry growth forecast between 2015 and 2020

Today, a major challenge for the worldwide building industry is the growing demand for sustainable construction. “Green” construction is transforming the way everyone designs, constructs and operates residential and commercial buildings. Analysts and experts agree that this sector is dramatically expanding:

- The Global Green Building Market Outlook 2020 forecasts that from 2015 to 2020, this industry will grow around 13 per cent (compound annual growth rate).
- McGraw Hill Construction’s “World Green Building Trends” summarizes that “green building is growing across the globe.”

As green construction gains momentum, standards from ASTM International will continue to play a leading role in achieving the goals of industry, government, consumers and other stakeholders. Already, more than 200 ASTM standards make a valuable contribution to the sustainable built environment. These standards — along with new ASTM efforts in this area — are part of the foundation for the future of this growing industry.

ASTM Standards: Crucial for Green Codes and Rating Systems

ASTM standards impact the growth of sustainable buildings in the green building rating and certification programs embraced by the global construction industry. These programs help stakeholders navigate the complex field of sustainability by defining green building attributes and by establishing environmentally responsive practices.

One such effort is the International Green Construction Code (IgCC), launched to lead to more sustainable building practices globally. ASTM is one of five cooperating sponsors of the IgCC. Developed by the International Code Council, the IgCC is the first model code to include sustainability measures for an entire construction project and its site, from design through construction, certificate of occupancy and beyond. For both new and existing buildings, the IgCC provides code language related to energy conservation, water efficiency, site impact, building waste, material resource efficiency and more.

The 2015 version of the IgCC cites over 40 ASTM standards covering a wide range of areas, from air quality to thermal insulation. Among these are important standards in areas such as solar reflectance (C1549) and building water conservation (E2635).

Standards from ASTM and other leading organizations play an important part in establishing performance criteria for green building certification systems such as Leadership in Energy and Environmental Design (LEED) developed by the U.S. Green Building Council. Architects, contractors, material suppliers, realtors and facility managers increasingly rely on such systems, which recognize best-in-class building strategies and provide third-party verification in design, construction and operation.

Committee E60: Leading the Way in Sustainability Standards

ASTM Committee E60 on Sustainability is a significant contributor of standards for sustainability and sustainable development. Standards for the built environment are developed by Subcommittee E60.01 on Buildings and Construction, which has a portfolio of 10 specifications, test methods and guides, and a dozen new standards under development.

The subcommittee’s early efforts focused on clarifying and establishing common language on sustainability for building performance. This led to a standard for terminology (E2114), which promotes effective communications among industry stakeholders. Another crucial standard is E2432 on general principles of sustainability, which defines three principles — environmental, economic and social — and identifies the core methodologies used to make the best decisions.

Subcommittee E60.01 also focuses on empowering industry to select building products for sustainable construction. Specifically, the standard for sustainability assessment of building products (E2129) applies to materials for both commercial and residential buildings.

More recently, the subcommittee released a standard that provides criteria for design teams to use in comparing the environmental impacts associated with a reference and a final building design. The standard (E2921 for whole building life cycle assessments) addresses material selection for initial construction, which takes into account maintenance and replacement cycles over time.

Among the E60 standards referenced in the IgCC is E2635 for water conservation in buildings, which describes an effective practice for water reuse. Through innovative technologies like in-situ water reclamation systems, buildings can conserve water much more effectively than in traditional construction.
Breaking New Ground

The International Green Construction Code (IgCC) is the first model code to include sustainability measures for an entire construction project and its site, from design through construction, certificate of occupancy and beyond.
Key Solar Standards

- E2527 for the performance of PV systems under natural sunlight
- E1171 for PV modules in cyclic temperature and humidity environments
- E2766 for installation of roof mounted PV arrays
- E3010 for the installation, commissioning, operating and maintenance process of a PV power plant
Committee E44: Using Solar Energy to Power Green Buildings

In the last several years, buildings with rooftop solar arrays have become increasingly common. According to the global consultancy McKinsey & Company, technological leaps and scaled up solar panel production have made solar power dramatically less expensive. What started as a technology used to power satellites, telescopes and other space vehicles is now used in homes, office buildings and warehouses. Solar farms now cover large parcels of land throughout the world.

For commercial building owners, solar offers a clean energy source that leads to lower utility bills, independence from the traditional power grid and a reduced carbon footprint. A growing demand is driving green builders to include solar arrays in design and construction projects.

This industry is supported by test methods, practices and guides from ASTM Committee E44 on Solar, Geothermal and Other Alternative Energy Sources. E44 has developed 50 standards that address many areas: heating domestic hot water; active and passive space heating and cooling; process heating; thermal conversion power generation; photovoltaic (PV) generation of electricity; and advanced energy conversion, including wind energy.

Assisting is Subcommittee E44.09 on Photovoltaic Electric Power Conversion, which helps green building developers measure solar system performance. This subgroup has developed more than 20 test methods for assessing PV systems in various conditions. These methods form the foundation of qualification standards developed by other national and international developers, such as the Institute of Electrical and Electronics Engineers (IEEE) and the International Electrotechnical Commission (IEC).

Key standards in this area include:
- E2527 for the performance of PV systems under natural sunlight, which details how to test and report the electrical performance of a photovoltaic concentrator module or system, and
- E1171 for PV modules in cyclic temperature and humidity environments, which provides industry with useful guidelines to assess module performance under varying conditions.

With dramatic growth in solar use, a need for best-practice guidelines in commercial PV installation has also grown. This has led to:
- E2766 for installation of roof mounted PV arrays, which addresses proper water-shedding integration with existing roof systems, water sealing of roof penetrations and sufficient anchoring per regional pressure load requirements, and
- E3010 for the installation, commissioning, operating and maintenance process of a PV power plant details the minimum requirements needed to ensure safe and reliable power generation for the expected plant life.

Subcommittee E44.05 on Solar Heating and Cooling Systems and Materials is another active E44 group. This group has developed a wide range of practices for safe and reliable design, installation and operation of solar heating and cooling systems. These standards are used by designers, manufacturers, distributors, installers, contractors, regulatory officials and building owners. For example:
- E424 for solar energy transmittance and reflectance helps building designers select and specify glazing materials and
- E683 for installation and service of solar space heating systems helps ensure adequate performance, safety and customer satisfaction.

Another important quality standard is E903 on solar absorptance, reflectance and transmittance of materials, developed by Subcommittee E44.20 on Optical Materials for Solar Applications. This test method helps manufacturers optimize system performance by assessing reliability, durability and performance of components.

The booming solar marketplace has led to a healthy climate for investors in large-scale solar installations. The McKinsey consultancy emphasizes that long-term solar energy contracting opportunities and insulation from fuel-price fluctuations are increasingly attractive. Institutional investors, insurance companies and major banks are becoming more comfortable with the risks (for example, weather uncertainty, component reliability) associated with long-term ownership of solar assets. The E3010 standard will guide stakeholders in due diligence for capital investments in large commercial solar projects.
Committee C09: Laying the Foundation for Sustainable Buildings

Continued growth in sustainable building is fueling initiatives in Committee C09 on Concrete and Concrete Aggregates. C09 has more than 1,500 members from 62 countries who manage over 175 standards, including key specifications for ready mixed concrete and concrete aggregates as well as tests supporting these standards.

Recently, the concrete industry grappled with establishing better practices for adding water to concrete at a job site. Two standards that support testing requirements and qualifications for the use of water — especially recycled water — in ready mixed concrete are:

- C1602, which covers mixing water for producing hydraulic cement concrete, and
- C1603, which details measuring solids in water. This is used to determine the solids content of mixing water for concrete when one or more of the water sources is wash water from concrete production.

C09’s sustainability work also addresses reuse of other industrial materials in concrete such as fly ash. Fly ash is used to improve workability, cohesiveness, finish and durability while consuming less energy, improving efficiency and enhancing building performance. C1697 covers ASTM-compliant blended supplementary cementitious materials for use in concrete or mortar. This standard is used alongside C311 for sampling and testing fly ash or natural pozzolans and C618 for coal fly ash and raw or calcined natural pozzolan for use in concrete.

Committee D08: Cooler Roofs Mean Lower Costs

Committee D08 on Roofing and Waterproofing covers a growing trend in green construction: “cool” roofs, which respond to solar energy by reflecting heat and emitting radiation back into the atmosphere. When less heat is absorbed into a building’s interior, occupants benefit from lower air-conditioning bills and a more controllable and constant indoor environment.

Cool roof materials help mitigate the sun’s effects, including asphalt shingles, metal, reflective coatings, roofing membranes and roofing tiles. These cool roofs can be installed atop low-slope roofs with flat rooflines (common in commercial, industrial, office, retail and multifamily buildings) as well as steep-slope roofs.

Subcommittee D08.18 on Nonbituminous Organic Roof Coverings plays a valuable role in promoting cool roof systems through two key standards: E1918 on solar reflectance and E1980 for calculating solar reflectance index. These standards help designers and consumers choose the cool roof materials most suitable for their building requirements.

Using Green Materials to Build

Green builders pay close attention to details that come into play throughout a building’s life cycle. They consider the location of the building, the amount of resources it consumes, how the building will impact the environment and more. Negative environmental impacts can be minimized through responsible and intentional use of green materials. Products that contain a high percentage of renewable resources have a lighter environmental footprint and are promoted in rating systems such as LEED. Material durability is also an important consideration in helping to reduce costs and limit environmental impact.

Many ASTM committees are supporting the use of high quality, environmentally friendly materials in construction.

For example, Subcommittee D18.14 on Geotechnics of Sustainable Construction (part of Committee D18 on Soil and Rock) has three standards for combining industrial byproducts with earth materials. Among these is D7760 on tire derived aggregates (TDA), a construction material made from recycled car tires. TDA is an alternative to stone aggregate in cases such as lightweight backfill behind foundations and retaining walls. This standard also supports testing of hydraulic conductivity, which is required in various civil engineering applications of TDA.

In addition, many ASTM standards support products and systems that make buildings more energy efficient and reduce utility costs:

- Committee C24 on Building Seals and Sealants develops standards for sealing building joints. The C920 specification for elastomeric joint sealants, widely cited in building codes, covers properties of a cured single- or multi-component sealant for buildings, plazas and decks.
- Committee C16 on Thermal Insulation supports efficient, nontoxic and affordable cellulose products made from post-consumer recycled newsprint, paper and cardboard. Standard C739 helps manufacturers understand the requirements for high quality cellulose insulation. This insulation has strong airtightness, which ensures greater heating and cooling efficiency as well as other benefits, such as mold resistance, as covered by C1338.

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Good acoustics are also an important aspect of IEQ, helping reduce fatigue and improve concentration among building occupants. Facility managers look to mask outdoor sounds such as traffic and reduce noise that travels through ceilings, floors, and systems such as air conditioning and heating units.

Committee E33 on Building and Environmental Acoustics supports this area through standards such as:
- E1573, a test method for evaluating masking sound in open offices,
- E1332 for rating outdoor-indoor sound attenuation, and
- E492 for laboratory measurement of impact sound transmission and its companion method E1007 for field sound transmission measurement.

**D22 and E33: Enhancing Indoor Environmental Quality**

In recent years, indoor environmental quality (IEQ) has emerged as a focus area for sustainable building design and is included in the LEED rating system. IEQ takes into account how the entire indoor environment contributes to an occupant’s overall well-being. Two important aspects of IEQ are air quality and acoustics.

Ventilation systems that bring in fresh air without losing heat in winter and coolness in summer help control pollutants and provide consistent comfort. Measuring and testing building air quality is the focus of Subcommittee D22.05 on Indoor Air, part of Committee D22 on Air Quality. Among the subcommittee’s large portfolio of standards are:
- D6245, which supports continuous monitoring of indoor and outdoor carbon dioxide as a guide for evaluating building ventilation and indoor air quality,
- D6306 for the placement and use of diffusion controlled passive monitors for gaseous pollutants,
- F1471 for air cleaning performance of a high efficiency particulate air-filter system, and
- D6670 on determining volatile organic emissions from indoor materials and products to understand their impact on indoor air quality.

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An important recent addition to E06's portfolio is E2947 for building enclosure commissioning, a process to help ensure that construction projects meet or exceed owner requirements. E2947 provides recommendations from project planning through design, construction, and occupancy and operation.

Finally, Committee E50 on Environmental Assessment, Risk Management and Corrective Action helps with assessing building performance. Green building owners benefit from standards such as E2797, which provides a commercially useful practice for conducting and reporting energy performance assessments on buildings involved in real estate transactions.

Helping with Product Category Rules and Environmental Product Declarations
Along with global growth in sustainable building construction has come a rise in “green” product claims from manufacturers and suppliers. Understanding the meaning and validity of these claims, whether based on certification programs or individual company assertions, is becoming increasingly difficult.

Building designers, contractors, consumers and code officials need credible information on environmental impact to make informed choices when purchasing products that claim sustainability. Manufacturers also need programs that help them establish credibility in this growing market while also providing greater awareness of how their products and practices affect the environment.

One of the key tools to help manufacturers assess the true greenness of their products is the environmental product declaration (EPD), a detailed report outlining a product’s effect on the environment over its lifetime. Product category rules (PCRs) are the guidelines for developing environmental declarations for products that can fill equivalent functions.

ASTM International is a Program Operator for developing PCRs and verifying EPDs, ensuring that proper procedures are followed. Already, ASTM has helped the following industries: membrane roofing, lightweight aggregate, gypsum, wood door leaves, joint compound, masonry product, plastic plumbing, cement and concrete.
ASTM Standards for Sustainability in Building: Online Compilation

The standards discussed in this overview are included in ASTM Standards for Sustainability in Building, an online compilation of 200+ ASTM International standards that address sustainability in buildings and construction. This resource is pertinent to almost any green rating system or code in the marketplace.

www.astm.org/SUSTAINBLDG
The ASTM technical committees highlighted in this piece include:

- C09 on Concrete and Concrete Aggregates
- C16 on Thermal Insulation
- C24 on Building Seals and Sealants
- D07 on Wood
- D08 on Roofing and Waterproofing
- D18 on Soil and Rock
- D20 on Plastics
- D22 on Air Quality
- E06 on Performance of Buildings
- E33 on Building and Environmental Acoustics
- E44 on Solar, Geothermal and Other Alternative Energy Sources
- E50 on Environmental Assessment, Risk Management and Corrective Action
- E60 on Sustainability