For more than a century, the global building industry has partnered with ASTM International to support the high quality design, construction and performance of homes, offices and other facilities around the world. Through its diverse range of technical standards and related products and solutions, ASTM helps buildings rise safely and economically while empowering industry stakeholders to respond to changing market requirements and evolving consumer needs.
Propelling Green Construction into the Mainstream

A major focus of the worldwide building industry today is the growing demand for sustainable construction. Sustainable or “green” construction focuses on the most effective use of resources and ultimately the creation of healthier, energy efficient, more environmentally friendly homes and buildings. The move toward sustainability is transforming the way the industry designs, constructs and operates buildings. Evidence of this shift can be seen in green roofing systems atop office buildings in major international cities and the rise of green construction in the residential housing market. According to a study by McGraw-Hill Construction, green housing projects accounted for 20 percent of all newly built homes in 2012 and had an overall value of $25 billion. In the United States alone, the firm estimates that this share will grow to between 29 and 39 percent of new homes by 2016.

As this momentum increases, standards and solutions from ASTM will continue to help fulfill the goals of this industry and the needs of consumers. Already, over 200 ASTM standards help guide the design and construction of more sustainable buildings.

ASTM Standards: Technical Foundation of Codes and Rating Systems

ASTM standards impact the growth of sustainable buildings through rating and certification programs. These programs help stakeholders navigate the often complex field of sustainability, defining green building attributes and guiding environmentally responsive practices.

One such effort is the International Green Construction Code (IgCC), launched with the goal of fostering sustainable building practices around the globe. Developed by the International Code Council, the IgCC is the first model code to include sustainability measures for construction projects and sites from design through construction, certificate of occupancy and beyond. For both new and existing buildings, the IgCC provides code language for energy conservation, water efficiency, site impacts, building waste, material resource efficiency and more.

ASTM International is one of five sponsors of the IgCC and its latest version, which cites more than 40 ASTM standards on various aspects of building construction. Among these are E2399 on green roof systems, C1549 on solar reflectance and E2635 on water conservation in buildings. More than a dozen ASTM technical committees have standards referenced in the IgCC on topics ranging from air quality to thermal insulation.

ASTM standards also help establish performance criteria for LEED (Leadership in Energy and Environmental Design), a globally recognized certification system. Architects, contractors, material suppliers, realtors and facility managers rely on LEED to design, construct and operate commercial buildings, houses, schools and more. LEED addresses the entire building life cycle and recognizes best-in-class building strategies; it also provides third-party verification for green buildings. Every day, more than 1.5 million square feet (0.14 Mm²) of space is certified using LEED. The latest version of the program, LEED v4, was approved in July 2013.

ASTM Committee E60: Leading the Way in Sustainability Standards

Since 2008, ASTM Committee E60 on Sustainability has developed technically sound, market-relevant standards that promote sustainability and sustainable development. Standards for the built environment come from Subcommittee E60.01 on Buildings and Construction. E60.01 established common language on sustainability in building performance: standard E2114 on terminology for sustainability promotes more effective communications among industry stakeholders. Another groundbreaking standard is E2432 on general principles of sustainability, which defines three areas — environmental, economic and social — and the core approaches to decision making used in pursuing sustainability.

Subcommittee E60.01 addresses the selection of building products in another standard, providing instructions on collecting data to help evaluate the sustainability of building products for both commercial and residential buildings (E2129).
Progress
The development and installation of sustainable roofing systems is increasing on a wide range of buildings.

Advancing Innovation in Green Roofing Systems
ASTM Subcommittee D08.24 on Sustainability, part of Committee D08 on Roofing and Waterproofing, is focused on a dynamic and growing aspect of sustainable building construction: green roofs. A green roof, or rooftop garden, is a vegetative layer grown to:

- Provide shade and remove heat from the air;
- Reduce the temperature of the roof surface and the surrounding air;
- Reduce air pollution and greenhouse gas emissions;
- Enhance stormwater management and water quality; and
- Improve the aesthetics of both office buildings and homes.

Green roof designs fall into two general categories: those with drought-tolerant plants such as sedums for extensive vegetative green roofs and complete landscape gardens for intensive vegetative green roofs. In both approaches, green roofs help fulfill core sustainable construction goals.

Design, material selection, installation and maintenance considerations are all part of implementing a green roof system. D08.24 has helped meet the growing need for guidance in this industry with standards for structural design, water permeability, system performance, irrigation requirements, plant and related material selection and more. For example, E2399 on green roof systems provides designers with a method for replicating field conditions on green roofs and evaluating performance before construction.

Choosing plants is also crucial to a successful green roof system because rooftops often have strong and variable wind patterns and little protection from the sun’s heat and ultraviolet radiation. E2400 on selecting, installing and maintaining plants for green roof systems is crucial, offering recommendations for choosing, planting and irrigating plants.

Overall, standards have helped bring down early adopter costs, spurring the use of green roofs on a global scale. A growing industry of green roof professionals has blossomed and has guidance with standards, including one covering a comprehensive approach to designing, planning and installing vegetative green roofs (E2777). The standard
Cool Roofs reflect heat and radiation back into the atmosphere.

helps practitioners identify the characteristics of green roof systems consistent with the core sustainability principles outlined in ASTM E2432.

Additional standards for various aspects of sustainable roofing systems are underway in D08.24, including guides for selecting waterproofing membranes for green roofs.

Cooler Roofs with the Help of D08 Standards
Another important green construction area is “cool” roofs, an approach that reflects heat and radiation back into the atmosphere. When less heat is absorbed into a building’s interior, occupants benefit from lower air-conditioning energy use and a more controllable and constant indoor environment. An array of cool roof materials helps mitigate the sun’s effects, including asphalt shingles, metal, reflective coatings, roofing membranes and roofing tiles.

Cool roof techniques can be used in low slope roofs (which have relatively flat rooflines and are installed atop institutional, commercial, industrial, office, retail and multifamily buildings) and steep slope roofs (which have an inclined roofline and are generally used on single family homes). Two standards developed by Subcommittee D08.18 on Nonbituminous Organic Roof Coverings play a valuable role in cool roof installation. Standards such as E1918 on solar reflectance and E1980 for calculating solar reflectance index help building designers and consumers choose suitable cool roof materials.

Solar Energy: Powering 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 increased solar panel production have driven down costs. The technology — first used to power satellites and telescopes — is now used in homes, office buildings, warehouses and solar farms covering acres of land.

For residential and commercial building owners, solar power leads to lower utility bills, independence from the traditional power grid and a reduced carbon footprint. Growing demand is driving green builders to incorporate solar arrays in design and construction projects. Supporting their efforts are numerous standards developed by Committee E44 on Solar, Geothermal and Other Alternative Energy Sources. E44 standards touch on a wide range of clean energy applications. For example, E2766 guides photovoltaic array installation on steep-sloped roofs.

In addition, glass, coatings, films and optical component manufacturers rely on E903 to evaluate the solar absorptance, reflectance and transmittance of their products. This standard helps with product development, optimization and performance.

Supporting Green Building Materials
A green home is much more than the sum of its parts — it also reflects its environmental impact. Green builders pay close attention to all the details that come into play during a building’s life cycle — including where it is built, the resources it consumes, how it affects the environment and what materials go into its construction. Negative environmental impact can be minimized by using and applying green materials. Products containing a high percentage of rapidly renewable resources have a lighter environmental footprint and are strongly promoted in the LEED rating system. Material durability is also an important consideration, helping to reduce life cycle costs and limit environmental impacts.

Numerous ASTM technical committees are driving the development of high quality, environmentally friendly materials that support green construction. A significant contribution is being made by Subcommittee D18.14 on Geotechnics of Sustainable Construction (part of Committee D18 on Soil and Rock), whose standards cover the use of industrial byproducts with earth materials in sustainable construction. Among these is D7760 on tire derived aggregates (TDA), a construction material produced from recycled vehicle tires. TDA can be used instead of stone aggregate in many construction applications, including lightweight backfill behind building foundations and retaining walls. D7760 also supports the testing of hydraulic conductivity, which is required in civil engineering applications of TDA.

D7762 on self-cementing fly ash guides the use of coal fly ash in stabilizing soils. This helps limit fill settlement below buildings. Similarly, D7765 covers methods and recommendations on reusing green foundry sands — discarded by the foundry industry — in embankment and structural fill applications.

Another group that supports the development of green building materials is Subcommittee D20.20 on Plastic Lumber (part of Committee D20 on Plastics). The subcommittee’s efforts help advance the use of plastic lumber products in boardwalks, decks, railings, bridges and more. As an alternative for treated lumber, plastic lumber products resist insects, rot, moisture and many chemicals. These products are composites made from a mix of plastics and fibers to enhance strength. Typically, plastic composites products benefit the environment by using recycled plastics and reducing waste.

D20.20 standards include tests for properties that indicate how plastic lumber will perform in conditions similar to the targeted construction setting, aiding
E903 on solar absorptance, reflectance and transmittance of materials
Manufacturers rely on E903 to evaluate their products. The standard helps with product development, optimization and performance.

A Growing Demand
For home and commercial facility owners, solar offers a clean energy source that leads to lower utility bills, independence from the traditional power grid and a reduced carbon footprint.
The LEED rating system on high performance of sustainable buildings now recognizes pervious concrete and offers recognition (“points”) when it is used for stormwater management.

Pervious concrete cannot be tested using traditional concrete standards because of its porosity. That’s why Subcommittee C09.49 on Pervious Concrete created C1688, which helps verify that freshly mixed pervious concrete delivered to a project corresponds to the producer’s mix proportions. Also, C1701 on in-place pervious concrete is used to detect infiltration rate reduction, identifying any need for remediation.

Subcommittee C27.70 on Precast Concrete Products for Stormwater Management (part of Committee C27 on Precast Concrete Products) also supports this field. Regulatory agencies and testing laboratories use ASTM standards aimed at reducing water pollution and controlling erosion. For example, a new testing protocol for stormwater hydrodynamic systems (used to remove settleable solids that could cause contamination from stormwater runoff) is under development.

Establishing Sustainability with Environmental Product Declarations

Along with the global growth in sustainable building construction has come a rise in “green” product claims from material manufacturers and other industry suppliers. Understanding the meaning and validity of these claims, whether they are based on certification programs or individual company assertions, is becoming increasingly difficult.

To best determine the sustainability of a product, building designers, contractors, consumers and code officials need credible information on environmental impact to make more informed choices. Manufacturers also benefit by tapping into the growing market for green building materials and through greater awareness of how their products and practices affect the environment. One of the key tools available 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 the course of its lifetime.

In 2012, ASTM International became a Program Operator for developing product category rules (PCRs) and verifying EPDs in response to the growing need to understand the real environmental impact of products — from raw material extraction to disposal and recycling. PCRs detail the rules and guidelines for developing environmental declarations for products that can fill equivalent functions. EPDs will be verified in accordance with the International Organization for Standardization (ISO) 14025 standard and to ensure that life cycle assessment data accurately describes the environmental aspects of a product. ASTM technical advisory committees provide specific industry knowledge to the development process for PCRs.

ASTM International is helping many industries in developing PCRs and verifying new EPDs, making sure that all proper procedures are followed. Industry-specific efforts in developing PCRs are currently underway with the following organizations:

- American Concrete Pipe Association
- Asphalt Roofing Manufacturers Association
- Builders Hardware Manufacturers Association
- Canadian Precast/Prestressed Concrete Institute
- Concrete Masonry Association of California and Nevada
- Drywall Finishing Council
- Expanded Shale, Clay and Slate Institute
- Gypsum Association
- Interlocking Concrete Pavement Institute
- National Concrete Masonry Association
- National Precast Concrete Association
- Plastic Pipe and Fittings Association
- Portland Cement Association
- Precast/Prestressed Concrete Institute
- Single Ply Roofing Industry
- Slag Cement Association
- Wallcoverings Association
- Window and Door Manufacturers Association

Pervious surfaces

Pervious concrete advances sustainable development goals by mitigating pollution; protecting streams, watersheds and ecosystems; reducing surface temperatures and heat island effects; and eliminating the need for expensive collection and detention systems.
Efficient

High performing buildings have small ecological footprints and create a healthy indoor environment for the user.

ASTM Committee E06: Raising the Bar for High Performance Buildings

Today’s high performing green buildings share a common characteristic: they do more with less. High performing buildings have small ecological footprints and create a healthy indoor environment for the user; they meet occupants’ functional and aesthetic needs while scoring gains in energy efficiency, materials use and sourcing, water efficiency, carbon footprint, construction practices and indoor air quality. Some “net-zero” homes, built on the cutting edge of sustainable development, are so efficient that they generate a large portion of their own energy.

Helping green construction stakeholders to fulfill their vision for high performing homes and buildings is the diverse range of standards from Committee E06 on Performance of Buildings. The committee addresses the overall performance, improvement, and management of buildings and related facilities. Notable E06 standards that provide valuable utility in sustainable building-related applications include E2634 on flat insulating concrete forms (ICF), developed by Subcommittee E06.21 on Serviceability. This standard focuses on the use of ICF systems as energy efficient building envelopes for both residential and commercial construction.

Airtightness and windtightness are core components in sustainable building design and construction. Controlling air leakage — unwanted flow of air through the external fabric of the building envelope — is central to energy efficiency and unnecessary heat loss. In addition, heat that escapes from buildings carries a significant amount of moisture. This can lead to damage to buildings and building materials, and may have a severe effect on the air quality of the living space. Two E06 standards that help green building stakeholders test and quantify the airtightness of a building envelope are E779 on air leakage rate and E1827 on airtightness of buildings. In addition, to help assess air leakage is another test method: E283 on air leakage through exterior windows, curtain walls and doors. A companion standard, E1105 on water penetration, outlines the procedures for testing the water resistance of installed exterior windows, skylights, doors and curtain walls.

Standards from Committee E50 on Environmental Assessment, Risk Management and Corrective Action also help with measuring and assessing building performance. Green building owners benefit from E50 standards such as E2797 on building energy performance. E2797 provides a commercially useful practice for conducting a building energy performance assessment for commercial real estate transactions.

High performance green buildings are also defined by their ability to offer high quality indoor air. This is achieved through ventilation systems that bring in fresh air without losing heat during winter or coolness during summer, control the source of pollutants, and provide predictable and consistent levels of thermal comfort. Air quality in the residential environment is the focus of the efforts of Subcommittee D22.05 on Indoor Air (part of Committee D22 on Air Quality). Among D22.05’s large portfolio of standards is D6245 on indoor air quality and ventilation. This standard details the use of continuous monitoring of indoor and outdoor carbon dioxide concentrations as a guide for evaluating building ventilation and indoor air quality.

Responsive

Environmental product declarations help manufacturers assess the true greenness of their products.

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 standards. This resource is relevant to almost any green rating system or code that users may come across in the marketplace.
Sustainability Standards Database
This comprehensive database references over 500 ASTM standards and 300 other standards and programs from other organizations involved in sustainability. The database is available at www.astm.org/sustainability.

ASTM Standardization News Information
Articles and other content on sustainability and construction topics are available from ASTM’s Standardization News magazine at www.astm.org/sn-construction and www.astm.org/sn-environmental.

Purchasing ASTM Standards
More than 12,000+ ASTM standards are used worldwide to improve product quality, enhance safety and facilitate trade. You can purchase individual standards; a volume that groups like standards together; a section that is comprised of several volumes covering an industry segment; or the entire collection. Print and online subscriptions are available. To browse ASTM standards, adjuncts, collections and learn more about purchasing options, visit www.astm.org/standards.

The ASTM technical committees highlighted in this piece include:
- C09 on Concrete and Concrete Aggregates
- C16 on Thermal Insulation
- C27 on Precast Concrete Products
- 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
- E44 on Solar, Geothermal and Other Alternative Energy Sources
- E50 on Environmental Assessment, Risk Management and Corrective Action
- E60 on Sustainability

Additional ASTM technical committees involved in the field of building construction include:
- A01 on Steel, Stainless Steel and Related Alloys
- C01 on Cement
- C11 on Gypsum and Related Building Materials and Systems
- C14 on Glass and Glass Products
- C24 on Building Seals and Sealants
- D04 on Road and Paving Materials
- D14 on Adhesives
- D35 on Geosynthetics
- E05 on Fire Standards
- E33 on Building and Environmental Acoustics
- F06 on Resilient Floor Coverings
- F17 on Plastic Piping Systems
- G03 on Weathering and Durability

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